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STUDENTS' SYNOPSIS SERIES

PHARMACOLOGY

D. M. COW

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PHARMACOLOGY

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STUDENTS' SYNOPSIS SERIES

PHARMACOLOGY

BY

DOUGLAS COW, M.D.

EXAMINER IN PHARMACOLOGY, UNIVERSITY OF CAMBRIDGE

WITH 15 ILLUSTRATIONS

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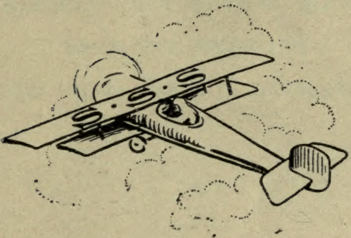

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TO THAT

GREAT ARMY OF MEDICAL STUDENTS

SOME EIGHTY PER CENT. OF THE WHOLE

WHO IN EXAMINATIONS

ARE WITHIN MEASURABLE DISTANCE

OF THE RUBICON THAT DIVIDES THE APPROVED

FROM THE REJECTED

THIS SMALL BOOK IS DEDICATED

PREFACE

This book is not intended in any way to take the place of the recognised text-books, but to be used in conjunction with them. It may be that during the usually crowded days preceding an examination the student has not the time necessary to read through his text-book. He may, however, have at his disposal the few hours necessary for a perusal of this small volume. Such a use of such a book is perfectly legitimate and does not constitute "cramming." The final reading through of condensed matter—and the contents of this book are, for the most part, very much condensed—will, it is hoped, serve to remind the student of the matter he has studied *in extenso* in the laboratory and in the text-book. On the other hand, any attempt on the part of a candidate for an examination in pharmacology to make himself acquainted with so important a subject solely by memorising a short résumé cannot be deprecated too strongly; such an attempt could but result in failure to appreciate the subject thoroughly, to the lasting loss to the individual, even though he manage to scrape through his examination. The author, no less than other teachers or examiners, hopes that such "cramming" will not be attempted.

The alphabetical arrangement of the matter, which does away with the necessity for an index, will, it is hoped, make reference to any particular subject an easy matter; at the same time it may be that the cross-references, which will be met with in a cover-to-cover reading, will, if followed out, impress the student's memory quite as strongly as the more usual text-book arrangement of the matter.

The statutory courses in pharmacology are becoming more and more—and rightly—the stepping-stone between physiology and the initiation of the student into clinical study. It follows as a logical corollary that dosage, pharmacopœial preparations of drugs and the rest of materia medica should be left to impress themselves on the student's mind during his clinical work. Any attempt to make the student memorise doses, preparations and so forth, before he enters the wards, can only mean that his memory becomes crammed with a mass of comparatively meaningless facts, forgotten as quickly as they are absorbed. If the acquisition of this knowledge is left to take care of itself the student, as a rule, automatically picks up a good working idea of the comparative toxicity of the more important drugs during his course in pharmacology: the rest sinks in equally automatically during his clinical studies. Knowledge so acquired is retained far better than that which is picked up parrot-fashion. The usual garnishings of materia medica, therefore, have purposely been omitted from this book: the official doses are given under the various drugs, and under the head, "pharmacopœial preparations," is given a brief outline of the general characters of the official preparations.

I am indebted to Dr. Inchley for valuable help in reading proofs.

D. C.

Cambridge.

SYNOPSIS OF PHARMACOLOGY

ABRIN, a vegetable toxin contained in the seeds of Jequirity. See under **Toxins.**

ACACIA. See under **Demulcents.**

ACETA. See under **Pharmacopœial preparations.**

ACETANILIDE, syn. Antifebrin, *gr.* 2–5 (0·12–0·3 *Gm.*). See under **Antipyretics.**

ACETATES have no specific action, are somewhat irritant, in large doses being liable to produce nausea and vomiting. In the **stomach** they are partially decomposed by HCl. **Absorption** takes place fairly readily from the small intestine. They are oxidised **in the tissues** forming carbonates, thus rendering the tissues more alkaline. During oxidation the acetates yield energy: they cannot, however, replace foodstuffs, since, if taken in quantity, they produce nausea and vomiting and the equilibrium of the body-fluids would be upset from the salt-action induced. **Excretion** is by the urine in the form of carbonates, thus rendering the urine alkaline.

ACETYLATOXYL, syn. Arsacetin, *gr.* ½–3 (0·05–0·2 *Gm.*). See under **Arsenic.**

ACETYLSALICYLIC ACID, syn. Aspirin, *gr.* 5–15 (0·3–1 *Gm.*). See under **Antipyretics.**

ACIDS. With the exception of certain acids, such as salicylic and prussic which have more specific actions on certain tissues, the pharmacological action is due to the liberation of H ions. Dilute acids neutralise alkalies; concentrated acids also precipitate protein and abstract water from the tissues. In these ways they act as **general**

protoplasmic poisons. In the **mouth** there is a reflex increase in salivary secretion; in the **stomach** there is no increase in secretion, but the acid introduced increases the amount available for peptic digestion, and so is of use in cases of deficiency of the natural HCl of the gastric juice. In the **duodenum** an increase of pancreatic secretion follows as a result of the increase in the amount of acid reaching it from the stomach. **Absorption** is rapid from the small intestine, with conversion into salts in the **tissues. Excretion** takes place in the urine in the form of salts.

ACOCANTHERA contains a glucoside, Ouabaine, which appears to be identical with g-strophanthin. See also under **Digitalis.**

ACONITINE, an alkaloid obtained from the root of Aconitum napellus (Monkshood), *gr.* 1/600–1/200 (0·0001–0·0003 *Gm.*). **General.** Stimulation followed by depression of all sensory nerve-endings and of nerve-endings in sweat-glands—transient initial stimulation followed by a more marked and lasting depression of the medulla (most of the symptoms usually referred to direct medullary action could quite well be elicited as reflex effects following the initial general stimulation of sensory nerve-endings). The **heart** is at first slowed by vagal stimuli; later it beats much more rapidly, later still becoming irregular, arrhythmic and passing into fibrillary twitchings, owing to a greatly increased irritability of the cardiac muscle. **Blood-vessels** are constricted from medullary stimulation. Blood-pressure falls at first from the cardiac slowing which is more intense than the simultaneous vasoconstriction. **Respiration** after a brief initial stimulation becomes greatly depressed, death occurring after poisonous doses from respiratory failure. The **body-temperature** is lowered partly from increased secretion of sweat and partly from an action on the thermogenic centres. The more noticeable symptoms, such as sneezing, coughing, nausea and vomiting are referable to reflexes set up by the stimulation of sensory nerve-endings. **Excretion** takes place chiefly in the urine.

Subcutaneous injections should be avoided, since they produce great pain from stimulation of sensory nerve-endings at the seat of injection. Aconitine was at one time largely used to lower the body-temperature in febrile conditions; nowadays it is but little used.

ADEPS (lard). See under **Pharmacopœial preparations.**

ADRENALIN—$(OH)_2 . C_6H_3 . CHOH . CH_2NHCH_3$—the active principle of the medullary portion of the suprarenal gland. A 1–1000 watery solution of adrenalin chloride is used in medicine, ♏ 10–30 (0·6–1·8 cc.). Natural adrenalin is lævorotatory, whilst the synthetic amine is optically inactive (consisting of equal parts of l- and d-rotatory isomers): lævo-adrenalin is some twelve times more active physiologically than dextro-adrenalin.

In **substitution-therapy** in the treatment of suprarenal insufficiency (Addison's disease) adrenalin has not proved to be of much value. Cf. thyroid extract in the treatment of myxœdema.

General. Stimulation of all sympathetic myoneural junctions: all the physiological actions of adrenalin are referable to this peripheral sympathetic stimulation. **Outside the body** adrenalin is itself insoluble in water, but its salts are readily soluble: it is very rapidly oxidised in the air, taking on a pink colour as oxidation proceeds. Applied locally to mucous membranes some is absorbed producing an intense local vasoconstriction which impedes further absorption. In the **mouth** and **stomach** local ischæmia of the mucous membrane is produced: adrenalin is rapidly destroyed in the stomach, little or none being absorbed when given by the mouth. If given by subcutaneous injection such intense local vasoconstriction is produced around the seat of injection that but little is absorbed. After intravenous injection the typical effects of the drug are elicited: these are extremely rapid in onset and pass off equally quickly. The **blood-vessels** are powerfully constricted with the few exceptions of those vessels which receive a predominantly dilator nerve-supply: such vessels are dilated. Certain other vessels which have a relatively weak vasomotor innervation may be passively dilated owing to the very high blood-pressure which results from vasoconstriction elsewhere. Adrenalin appears to constrict capillaries as well as arterioles. The **heart** is quickened and the force of its beat is increased. In the intact animal a secondary reflex slowing of the heart may be seen, referable to medullary stimulation by the high blood-pressure. This secondary slowing is never seen in the atropinised animal. The **blood-pressure** is very much raised on account of the general vasoconstriction helped by the increased output of the heart. Minute doses of adrenalin lower the blood-pressure from vasodilatation, the dilator nerve-ends are apparently affected by such very low concentrations before the constrictor. As little as 0·000001 *Gm.* of adrenalin is sufficient to produce a noticeable effect on the blood-pressure of a cat of average size. The **pupil** is dilated by adrenalin when the drug reaches the iris through the circulation: when instilled into the conjunctival sac it usually fails to affect the pupil, since the local vasoconstriction is so intense as to stop absorption in this way. The **bronchioles** are dilated, the plain muscle of the **intestine** is relaxed and peristaltic movements are inhibited (the ileo-colic, the pyloric and internal anal sphincters are contracted by adrenalin, as is the muscularis mucosæ). The effect of adrenalin on the **kidney** is that which results from constriction of the renal vessels: less blood flows through the kidney and the flow of urine is diminished. The **sweat-glands** appear at first sight to be an exception to the general rule that adrenalin stimulates all sympathetic myoneural junctions: one would naturally expect to find an increase in the secretion of sweat, but this does not, as a rule, occur: it may be that the innervation of the sweat-glands is not truly sympathetic or possibly the failure of the glands to secrete is referable to the intense vasoconstriction and the diminished flow of blood through the glands. The effect of adrenalin on the **uterus** varies according to the species of animal, and in some species according to the functional condition of the organ, but in every case the action of adrenalin is to reproduce faithfully the effect of electric stimulation of the hypogastric nerve. Thus adrenalin contracts the uterus of the rabbit, monkey and man; it relaxes the uterus of the guinea-pig, rat and mouse; it contracts the pregnant and relaxes the non-pregnant uterus of the cat. (See also under **Uterus**.) In large doses adrenalin frequently produces glycosuria.

It follows that adrenalin may be used to stop hæmorrhage from any part to which it can be applied locally. It may be injected locally or applied to a mucous membrane in order to produce a local vasoconstriction and so render bloodless the field of a small operation. Similarly it may be injected with cocaine when the local anæsthetic effect of the latter drug is required: given in this way adrenalin hinders the absorption of the cocaine and so minimises or prevents the general cocaine action. In the same way adrenalin, if injected round the site of a snake-bite, will prevent or delay the absorption of the venom. Adrenalin may be used in the treatment of acute spasmodic asthma to relax the bronchioles, to raise the blood-pressure in cases of shock or to revive a failing heart (adrenalin should be avoided in the cardiac inhibition of the early stages of chloroform narcosis: in such cases adrenalin might be the means of inducing a fatal fibrillation of the ventricles). See also under **Amines.**

AGAR-AGAR (Japanese isinglass) is used in preparing culture media for bacteriological work. See also under **Purgatives.**

AGARICIN, syn. Agaric acid, is obtained from Agaricus albus; it is an intense irritant to mucous membranes, producing vomiting and purgation when swallowed. It appears first to stimulate and then to depress the CNS, especially the medulla. Peripherally it paralyses the terminations of secretory nerves in the sweat-glands: it apparently has no depressant action on other secretory nerves nor on other sympathetic or cranio-sacral autonomic nerves.

ALCOHOL (ethyl alcohol) when applied to the **skin** evaporates, cooling the part. It absorbs water and precipitates proteins, thus hardening any tissue to which it is applied (e. g. the use of absolute alcohol in the preparation of microscopical sections). If rubbed into the skin it produces a **rubefacient** action. In the **mouth** a reflex flow of saliva and other reflexes, such as quickening of the pulse, are seen. In the **stomach** in suitable dilution alcohol directly stimulates the secretion of gastric juice, but it does not increase the secretion of pepsin. **Absorption** is very rapid from the stomach, little remaining to be absorbed from the duodenum. Alcohol hastens the absorption of bodies dissolved in it. After absorption the CNS is depressed from above downwards (Schmiedeberg). The effects thought by the man in the street to show that alcohol is a stimulant—garrulity, restlessness, inability to stop saying and doing silly things—are simply referable to the fact that the higher psychical centres are depressed first, thus setting free from control the more automatic motor area, with a consequent appearance of motor stimulation. Later on the motor areas, medulla and even the cord may be similarly depressed. After toxic doses death occurs from paralysis of the respiratory centre. (According to the theory of Binz an initial stimulation precedes the depressant action.) The **heart** is stimulated to a slightly increased output by small concentrations of alcohol: this appears to be the result of a direct action on the cardiac muscle and may be caused simply by the fact that alcohol is a readily combustible and assimilable source of energy. This cardiac effect is but small, and in the intact animal is usually overshadowed by reflex effects. The splanchnic **blood-vessels** are made to constrict by small concentrations of alcohol, whilst the surface vessels are dilated: larger concentrations dilate all vessels. **Blood-pressure** is very slightly raised from a summation of the cardiac and vascular effects. The **body-temperature** is lowered, since the rate of heat-loss is increased owing to cutaneous vasodilatation. **Respiration** is somewhat increased, an effect which is secondary to increased muscular movements and increased metabolism. The amount of work performed by striped **muscle** is at first slightly increased and later diminished, the nett result being a diminution. The effect of alcohol on **metabolism** is complex: small doses are almost completely oxidised in the tissues, about 2 per cent. only of the amount taken being excreted unchanged. It can be shown that the energy set free by the oxidation of alcohol spares the consumption of the fats and carbohydrates. On the other hand, until a certain degree of tolerance has been established the breaking down of the tissue proteins is actually increased; but when the tissues have become tolerant a certain amount of protein metabolism is also spared. Alcohol, then, in moderate doses may be regarded as a source of energy for the animal body, as for any other type of engine; it cannot, however, be regarded as a food, since it is not stored up in the tissues as a fuel supply, and such energy as is set free by its combustion is available at the time only and not for future needs. The small amount of alcohol which is not oxidised in the tissues is **excreted** in the urine.

ALKALIES owe their pharmacological activity to the liberation of OH ions. They neutralise acids, combine with proteins to form alkali albumens, saponify fats and exert a certain disinfectant action. On the **skin** alkalies have a cleansing action owing to their power of saponifying the fatty bodies which it contains. In strong concentration they act as caustics (a) by dehydration and (b) by combining with albumen. In the **mouth** salivary secretion is inhibited. In the **stomach** alkalies diminish the secretion of gastric juice and neutralise the HCl already present: they are used in this way in the treatment of hyperchlorhydria. In the **duodenum** the secretion of the pancreas is inhibited owing to the diminished acidity of the duodenal contents. **Absorption** takes place from the small intestine in the form of carbonate and possibly as alkali albumen. The alkalinity of the tissues is increased. The secretion of mucus in the **respiratory** passages is diminished, and the deposition of crystals of **uric acid** is prevented, though uric acid, which has already crystallised out, is not re-dissolved by the exhibition of alkalies. **Excretion** takes place in the urine in the form of carbonate, which makes the urine alkaline: the excretion of urine may be slightly increased by salt action.

ALKALOIDS are organic nitrogen compounds, alkaline in reaction, which combine with acids to form salts. Most alkaloids have a very bitter taste. The base is, as a rule, much less soluble in water than are its salts. Some alkaloids, such as pilocarpine, nicotine and sparteine, are liquid, though their salts are solid crystalline bodies.

ALOES, *gr.* 2–5 (0·12–0·3 *Gm.*). See under **Purgatives.**

ALOIN, *gr.* $\frac{1}{2}$–2 (0·03–0·12 *Gm.*), a yellow crystalline derivative of anthraquinone obtained from aloes. See under **Purgatives.**

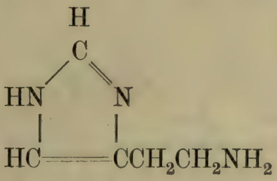
ALUM—aluminium potassium sulphate—*gr.* 5–10 (0·3–0·6 *Gm.*). See under **Emetics.**

AMINES—decarboxylation products of amino acids. Several amines are of pharmacological importance, thus histamine (*β*-iminazolylethylamine) from histidin, and tyramine (*p*-hydroxyphenylethylamine) from tyrosine, are found in ergot, and it is largely owing to the presence of these amines that ergot is an active pharmacological agent.

It is found that a similar sympathomimetic action is possessed by a whole series of amines, and, generally speaking, the nearer an amine approaches adrenalin (methylaminoethanol catechol) in chemical structure the more truly sympathomimetic is its action. Thus—

Adrenalin, $(OH)_2 \cdot C_6H_3 \cdot CHOHCH_2 \cdot NHCH_3$
Methylaminoethylcatechol, $(OH)_2 \cdot C_6H_3 \cdot CH_2CH_2NHCH_3$
p-Hydroxyphenylethylamine, $OH \cdot C_6H_4 \cdot CH_2CH_2NH_2$
Phenylethylamine, $C_6H_5 \cdot CH_2CH_2NH_2$

possess pharmacological actions all more or less sympathomimetic in type, whilst the action of histamine



shows but little similarity to the effects of sympathetic stimulation.

AMMONIACUM, *gr.* 5–15 (0·3–0·9 *Gm.*), a gum-resin obtained from Dorema ammoniacum. See under **Volatile oils.**

AMMONIUM. The action of the ammonium ion is in many respects similar to that of potassium. It produces a depressant effect on **muscle**—striped, cardiac and plain. It stimulates the CNS producing increased reflexes and convulsions. The brain is affected as well as the cord. (Cf. strychnine.) **Respiration** is stimulated and **blood-pressure** raised, both effects being due to direct medullary stimulation. Ammonium is an irritant to the **stomach** and so acts as an **expectorant.** Ammonium salts are more rapidly **absorbed** from the gastro-intestinal tract than are the corresponding salts of any other metal. **Excretion** is by the kidney, the carbonate being converted into urea, the citrate to the carbonate and this to urea, whilst other salts are excreted unchanged.

AMMONIUM CARBONATE, a mixture of carbonate and carbamate of ammonium, which gives off free ammonia—*gr.* 3–10 (0·2–0·6 *Gm.*) as expectorant, larger dose as emetic. (The maximum official expectorant dose is too large: if emesis is not desired the dose should not, as a rule, exceed five grains.) See also under **Emetics**.

AMYGDALIN, a glucoside contained in bitter almonds, which in the presence of water is split up by emulsin, a ferment contained in the almonds, into prussic acid, dextrose and benzaldehyde.

AMYL NITRITE, ♏ 2–5 (0·12–0·3 c.c.). See under **Nitrites.**

ANÆSTHETICS, drugs which produce unconsciousness (hypnotics—drugs producing sleep; narcotics—drugs producing coma). Anæsthetics are either—

(a) **General anæsthetics**, usually volatile bodies, such as chloroform and ether, which after absorption into the circulation exert a specific action on the CNS, producing anæsthesia. As a class the general anæsthetics are bodies easily soluble in lipoids, and to this property—ensuring a high concentration of the drug in the brain—according to Meyer and Overton, their action as anæsthetics is due. Many hypnotics, when given in massive dose, produce an anæsthetic effect.

(b) **Local anæsthetics,** bodies of widely varying chemical and physical characters, e. g. cocaine, prussic acid, phenol, which as their essential action paralyse sensory nerve-ends. See also under **Chloroform, Ether,** etc., **Cocaine, Prussic acid,** etc.

ANILIN, $C_6H_5 \cdot NH_2$, is chiefly of importance in pharmacology as being the body from which a large class of dyes and of antipyretic drugs is obtained. See under **Antipyretics.**

ANISE. See under **Volatile oils.**

ANTHELMINTICS, drugs which are used to remove intestinal parasitic worms from the body of the host. For the dislodgment or destruction of parasites which inhabit other parts than the intestine other means are employed. Anthelmintics may be classified according to the variety of worm for the expulsion of which they are used. It should be borne in mind that most anthelmintics are vermifuges rather than vermicides: it follows that a purgative should be used as an accessory to the anthelmintic.

Cestodes	Tænia Solium Tænia Saginata Tænia Bothriocephalus Latus	Filix Mas. Pelletierine. Cusso.
Nematodes	Ascaris Lumbricoides	Santonin.
	Oxyuris Vermicularis	Rectal enemata of salt or Quassia.
	Ankylostoma Duodenale	Thymol, Filix Mas.

Filix mas, the rhizome of the male fern (Aspidium filix mas) contains filicic acid and other bodies, derivatives of phloroglucin, to which the anthelmintic action is ascribed. Male fern taken by the mouth passes through the gastro-intestinal tract without being absorbed to any important extent, so producing an action on the parasite without producing any general effect on the host. In isolated cases enough of the drug is absorbed to produce symptoms in the host: these are gastro-intestinal irritation with vomiting and diarrhœa, jaundice, collapse, and sometimes coma and death. In a few cases optic neuritis and blindness have followed administration.

Pelletierine, *gr*. 2–8 (0·12–0·5 *Gm.*), an alkaloid found in the bark of the pomegranate, in which it occurs with other alkaloids of small importance, and with about 20 per cent. of tannic acid. Pelletierine is similar in structure to tropine (see under **Atropine**). Pelletierine seems to have a specific affinity for tape-worms, since these are killed by concentrations of the drug much lower than are required for an effect on other worms. Untoward symptoms in the host are rare, but large doses may give rise to a feeling of heaviness and weakness, apparently due to depression of the CNS.

Cusso, *gr*. 120–240 (8–16 *Gm.*), the dried flowers of Brayera anthelmintica, contains a neutral body, cussotoxin, a compound of phloroglucin and butyric acid. It is used only for its action on the tape-worm, which is affected by it very much as by male fern.

Santonin, *gr*. 1–3 (0·06–0·12 *Gm.*), a neutral crystalline body, allied to naphthalene, is found in the flowers of Artemisia maritima. Santonin has a more marked effect on the round worm than on tape-worms, and it seems to act by rendering the small intestine so unpleasant that the parasites in their endeavour to escape the drug move down to the large bowel, whence they are more easily removed by a purge. Toxic symptoms referable to absorption of the drug are seen not infrequently; these consist in yellow vision and other disorders of other special senses, coupled with epileptiform movements, nausea and vomiting —symptoms apparently referable to an action on the CNS. Santonin after certain changes in the tissues is excreted in the urine, which then takes on a deep tinge which, like that produced by chrysophanic acid, is changed to a purple colour on adding an alkali.

Thymol, *gr.* 15–30 (1–2 *Gm.*), a stearoptene obtained from the volatile oil of thyme, is absorbed only with difficulty from the alimentary canal, and so is capable of exerting an action on the ankylostoma in the small intestine in much higher concentration than obtains in the tissues of the host. If appreciable amounts are absorbed various unpleasant symptoms are produced: nausea, vomiting, roaring in the ears, with depression of the heart and collapse. Fatty degeneration of the liver has been found post-mortem. Thymol is excreted in the urine in the form of an ethereal sulphate and in combination with glycuronic acid. See also under **Volatile oils.**

Quassia (see also under **Bitters**) is used in the form of an infusion as a rectal enema to dislodge and wash out from the large intestine the oxyuris vermicularis or thread-worm.

Generally speaking, the use of an anthelmintic should be preceded by a purgative to free the gastro-intestinal tract from food, and so to ensure that the anthelmintic drug comes into direct contact with the parasite. A brisk purge should also follow the anthelmintic, to remove the stupefied worm from the bowel before it recovers and again attaches itself to the mucous membrane. In treating tape-worm disease it is of importance to make certain that the whole worm, including particularly the head-segment, has come away. In the thread-worm disease of children care should be taken that the child cannot scratch the neighbourhood of the anus and then suck its fingers, thereby transferring to its mouth the ova of the worm, and so introducing a fresh generation of the worm into the gastro-intestinal tract. Castor oil should be avoided as the adjuvant purgative when administering male fern, as there is some evidence that in the presence of oils the active principles of male fern are more readily absorbed from the gastro-intestinal tract.

ANTHRACENE PURGATIVES—rhubarb, senna, aloes, cascara. See under **Purgatives.**

ANTHRAQUINONE. See under **Purgatives.**

ANTIDOTES.

Poison.	Physiological Antidote.	Chemical Antidote.	General.
Acids, mineral		dilute alkali, chalk, wall-plaster, magnesia	demulcents, avoid stomach-tube
Acid, oxalic		chalk or wall-plaster	stomach-tube with caution
Acid, carbolic		wash out stomach with sulphate of Mg. or Na	demulcents, stimulants
Acid, prussic	medullary stimulants intravenously	hyposulphite of sodium intravenously	stimulants
Aconitine	medullary stimulants atropine		stomach-tube, emetics, stimulants
Alcohol	medullary stimulants		artificial respiration
Alkalies		dilute organic acids	stimulants, demulcents, avoid stomach-tube

Poison.	Physiological Antidote.	Chemical Antidote.	General.
Antimony		tannic acid	demulcents, warm water
Arsenic		fresh hydrated ferric oxide	stomach-tube, emetics, demulcents
Atropine	pilocarpine (useless for combating the respiratory paralysis), medullary stimulants	tannic acid	stomach-tube, emetics
Chloroform	atropine (infused into a vein with a quantity of saline) in the early stages. Medullary and cardiac stimulants in later stages		artificial respiration, cardiac massage
Cocaine	medullary stimulants		stomach-tube, emetics
Copper salts		potassium ferrocyanide	demulcents, stimulants
Digitalis		tannic acid	stomach-tube, emetics
Hypnotics	medullary stimulants		stomach-tube emetics
Irritants			demulcents, stomach-tube, emetics, stimulants
Lead salts		sulphate of Na or Mg, albumen, potassium iodide in chronic cases	stomach-tube emetics, demulcents, stimulants

Poison.	**Physiological Antidote.**	**Chemical Antidote.**	**General.**
Mercury salts		albumen	stomach-tube, emetics (not NaCl), demulcents
Morphine	medullary stimulants	potassium permanganate	stomach-tube, emetics, stimulants
Phosphorus		copper sulphate, potassium permanganate, turpentine	stomach-tube, emetics, demulcents (not oil)
Strychnine	medullary depressants	tannic acid	stomach-tube (only when under $CHCl_3$)
Zinc salts		tannic acid, albumen	stomach-tube or emetics with caution, demulcents

ANTIFEBRIN, syn. Acetanilide (q.v.).

ANTIMONY occupies a pharmacological position midway between arsenic and the heavy metals. It resembles arsenic in that both possess what amounts almost to a specific action on trypanosomes: again, when applied to the skin each may produce pustules and local necrosis. Simple salts of antimony, like the chloride, on the other hand, resemble the heavy metals in that they combine with albumen. Most of the symptoms produced by swallowing a dose of antimony are referable to the irritation set up in the stomach: similar effects are seen after a longer latent period if the drug is injected under the skin, since part is excreted into the gastro-intestinal tract. Thus an expectorant or emetic effect, according to the dose and the severity of the irritation produced, quickening of the pulse, respiratory changes and collapse may all be the result of the irritant action on the gastric mucous membrane. Antimony is **excreted** mainly by the intestine, smaller amounts are found in the urine, bile, sweat and milk. Antimony has been combined with arsenic in one of the more recent organic arsenicals used in the treatment of syphilis—luargol, which contains also a molecule of silver bromide in combination. The compound of antimony most commonly used in medicine is—

ANTIMONY TARTRATE, syn. Tartar emetic, a double tartrate of potassium and antimony, *gr.* 1/25–$\frac{1}{8}$ (0·0025–0·008 *Gm.*), as diaphoretic; *gr.* $\frac{1}{2}$–2 (0·03–0·06 *Gm.*) as emetic. See under **Emetics.**

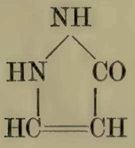
ANTIPYRETICS.

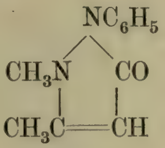
1. **Antifebrin, Phenacetin, Antipyrin** group.

Acetanilide (antifebrin) is a derivative of anilin, $C_6H_5 \cdot NH_2$, itself a powerful antipyretic, but too toxic to be used for this purpose in medicine. In acetanilide, $C_6H_5 \cdot NHCOCH_3$, the replacement of one of the hydrogens of the NH_2 of anilin gives a body much less toxic than anilin, but still possessed of considerable antipyretic power. In the tissues acetanilide is partly oxidised with the formation of *p*-amidophenol, $C_6H_4 \cdot OH \cdot NH_2$, a more toxic body which is liable to produce **methæmoglobin.** It is **excreted** in the urine in combination with glycuronic acid. Exalgin is a compound similar to acetanilide: in it both the hydrogens of the NH_2 of anilin are replaced, the one by an acetyl and the other by a methyl radicle, giving $C_6H_5 \cdot NCH_3COCH_3$. This is somewhat less toxic than acetanilide, though it, too, is liable to produce similar untoward symptoms.

Phenacetin is a direct derivative of phenetidin, $C_6H_4 \cdot C_2H_5O \cdot NH_2$, and bears the same relation to it as does acetanilide to anilin: that is to say, one of the hydrogens of the NH_2 is replaced by acetyl, giving $C_6H_4 \cdot C_2H_5O \cdot NHCOCH_3$. This is a body with considerably less toxicity than acetanilide and still possessed of adequate antipyretic action.

Phenazone (antipyrin) is dimethylphenylpyrazolon, two hydrogens of *iso*pyrazolon being replaced by CH_3 and a third hydrogen by C_6H_5. Thus—


*iso*pyrazolon


phenazone.

Phenazone is more soluble than either acetanilide or phenacetin: it is somewhat more toxic than phenacetin, considerably less toxic than acetanilide. It also is **excreted** in the urine partly in combination with glycuronic acid.

These drugs, whilst having but a slight action on the temperature of the normal animal, reduce the temperature of the febrile animal, especially in those conditions in which the temperature chart shows considerable daily intermissions. The temperature is lowered by these drugs through an increase in the heat loss, which they bring about by a dilatation of the surface vessels: more blood thus flows along the surface of the body and gives up its heat to the surrounding atmosphere. This action is thought to be a direct one on the heat-centres in the corpus striatum. As well as their antipyretic action these drugs possess a mild **hypnotic** and **analgesic** action. These effects, too, are produced by a direct action on the CNS. They have a slight **antiseptic** action, so slight as to be of no practical importance. The **heart** is slightly depressed, though not to a dangerous extent by ordinary therapeutic doses. A few people show a remarkable **idiosyncrasy** to these drugs; small doses produce in these individuals toxic symptoms similar to those produced in normal people by excessive doses—profuse perspiration, erythematous rashes, symptoms referable to the formation of methæmoglobin, nausea, vomiting, fainting and collapse.

2. **Salicylic acid** group.

The members of this group act as efficient **antipyretics** and **antiseptics,** and so occupy a pharmacological position midway between the phenacetin-antifebrin-antipyrin group on the one hand, and the group of aromatic antiseptics on the other hand. Salicylic acid, $OH \cdot C_6H_4 \cdot COOH$, lowers the body temperature in febrile conditions by increasing the heat loss; this is brought about by dilatation of surface vessels and profuse perspiration. At the same time metabolism and heat formation are increased, but the increase in rate of heat loss overcomes this and the nett result is a lowering of body temperature. Salicylic acid is readily **absorbed** from the gastro-intestinal tract and is found in the blood in the form of sodium salicylate. It is **excreted** in the urine in combination with glycocol as salicyluric acid (violet reaction with $FeCl_3$). In acute rheumatism salicylic acid has what amounts almost to a specific action, lowering the temperature and reducing the pain and swelling of inflamed joints very rapidly. Salicylic acid is somewhat irritant to the stomach, and various compounds are used in preference to it. **Sodium salicylate,** $OH \cdot C_6H_4 \cdot COONa$, is rather less irritant than salicylic acid, but it is partly decomposed in the stomach and the salicylic acid set free may produce irritation. In other respects its action is similar to that of salicylic acid. **Salicin,** a glucoside found in various willows, also is split up in the stomach, a certain amount of salicylic acid being set free. **Acetylsalicylic acid** (Aspirin), $OCOCH_3 \cdot C_6H_4 \cdot COOH$, for the most part passes through the stomach unchanged and in the duodenum is split up with the formation of salicylic acid. Aspirin is but very slightly soluble in water. **Methyl salicylate,** $OH \cdot C_6H_4 \cdot COOCH_3$, is used more frequently as an external application in the form of the natural oil of wintergreen, which, when rubbed into the skin is absorbed. **Salol,** $OH \cdot C_6H_4 \cdot COOC_6H_5$, the carbolic acid ester of salicylic acid is split up in the small intestine into salicylic acid and phenol. It is used entirely for its antiseptic action. See also under **Antiseptics.** Certain individuals show a marked idiosyncrasy to salicylic acid: the usual symptoms which are found in these people are roaring in the ears, a feeling of fulness in the head, dimness of vision, dulness of hearing, excessive perspiration, dyspnœa and collapse. Skin eruptions of an erythematous type are sometimes seen and abortion has occurred.

3. **Quinine,** *gr.* 1–4 (0·06–0·25 *Gm.*), is an alkaloid obtained from the bark of Cinchona. **Outside the body** quinine acts as a **general protoplasmic poison,** stopping the movements of cilia, of amœbæ, of leucocytes, etc., in concentrations of 1–50000. From this action in inhibiting and killing organisms quinine has a certain antiseptic action. In the **mouth** quinine has a strongly bitter taste and produces all the effects of a simple bitter (q.v.). Quinine and most of its salts are very insoluble in water, but are rendered more soluble by inorganic acids: thus in the **stomach** quinine is dissolved and passes unchanged into the duodenum, whence it is **absorbed** quite rapidly unless there is an excess of alkali present, in which case the alkaloid may be precipitated and pass through the intestine without being absorbed. Quinine acts as an **antipyretic** by diminishing heat production: this it does not by any central action, since the effect is not prevented by section of the cord. It is found that the temperature curve runs parallel with the metabolism curve, and it appears that the effect on the body temperature is entirely secondary to the effect on metabolism, which is lowered, the total solids in the urine, including urea and uric acid, being diminished by anything up to 50 per cent. On the **blood** quinine produces an effect, the leucocytes losing their amœboid movements, diapedesis stopping, and in consequence pus formation may be inhibited. All forms of **muscle** are affected, at first with small concentrations of the drug increased activity is seen, very soon passing in the case of stronger concentrations into a condition of diminished irritability, tonic contraction and death in rigor. Quinine possesses a "specific" action in **malaria.** It is powerless against the parasite as long as this remains

within the corpuscles; as soon, however, as the parasite undergoes fission and appears in its extracorpuscular phase quinine in suitable concentration in the blood kills it, and so is capable of cutting short an attack of ague. In treating malaria quinine should be administered during the twelve hours preceding an expected attack of ague (when the parasites become extracorpuscular), so that when the parasites emerge into the blood-stream the drug is already there in adequate concentration. Large doses of quinine may produce a train of symptoms known as **cinchonism**—nausea and vomiting, giddiness, headache, roaring noises in the ears, disturbances of vision, confusion of ideas, cyanosis and collapse with occasionally erythematous skin eruptions, hæmaturia and jaundice. **Excretion** takes place slowly, mainly in the urine, in which quinine is found unchanged, some appearing also in the saliva, the sweat and the milk.

Various derivatives of quinine are of importance. All are quinoline derivatives, and, generally speaking, possess pharmacological actions of the same type as quinine itself. The more important of these are quinidine, cinchonine, cinchonidine, hydroquinine, hydrocupreine (ethylhydrocupreine, syn. optochin, has been put forward as a specific against the pneumococcus, but it is apparently only in the lower animals that pneumococcal infections are cured by its use).

ANTIPYRIN, syn. Phenazone, *gr.* 5–15 (0·3–1·0 *Gm.*). See under **Antipyretics.**

ANTISEPTICS, drugs which inhibit the growth of organisms, preventing putrefaction. (**Disinfectants** or **germicides** kill organisms: most antiseptics in strong concentration are germicides; weaker concentrations of all germicides are antiseptic.) Antiseptics produce their action on organisms in one or other of the following ways—

(a) By **salt-action.** A hypertonic solution of any salt attracts water from the interior of the organism, drying it up and inhibiting its growth. In this way common salt is used as a preservative of meat and fish and sugar of fruits.

(b) By **oxidation.** Certain organisms, obligatory anærobes, cannot live in the presence of oxygen: these are inhibited by antiseptics which give off free oxygen.

(c) By **reduction.** Other substances owe their antiseptic action to the fact that they liberate hydrogen, in an atmosphere of which no ærobic organism can thrive.

(d) By **precipitation of protein.** Certain antiseptics combine with albuminous bodies which they precipitate: in this way the micro-organisms become ensheathed in an impervious envelope of precipitated albumen, and so are deprived of their source of nourishment.

(e) As **general protoplasmic poisons.** These directly poison the micro-organism; they have the disadvantage that they may at the same time poison the tissues of the host, if used against pathogenic organisms inhabiting the tissues of man.

1. **Mercuric chloride** (syn. Corrosive sublimate), $HgCl_2$, owes its antiseptic action to its power of precipitating protein. A 1–1000 solution is strong enough to kill most organisms in ten to fifteen minutes. It is toxic to all forms of living matter and forms albuminates wherever it comes into contact with protein. It is, therefore, directly toxic to the tissues of the host. It also corrodes metals and so is unsuitable for sterilising surgical instruments.

Mercuric iodide is a more powerful antiseptic than the chloride, but is insoluble in water. It is soluble in a watery solution of potassium iodide, but this is too expensive to use as a routine solvent.

Salts of other **heavy metals** act as antiseptics in much the same way as do mercury salts; they form albuminates when they come into contact with protein, but whereas the albuminate of mercury is soluble in excess of albumen and in saline, the albuminate, e. g. of lead is not soluble, and in consequence the salts of the heavy metals as a class have no penetrating power and can attack those micro-organisms only which lie on the surface.

2. **Coal Tar Antiseptics.**

Phenol (syn. Carbolic acid), C_6H_5OH, is an efficient antiseptic in ordinary concentration, but in order to produce a germicidal action must be used not weaker than about 1–20. It acts by precipitating protein, forming an insoluble albuminate which minimises its power of penetrating the tissues.

Benzoic acid, C_6H_5COOH, and—

Cinnamic acid, $C_6H_5CHCHCOOH$, possess fairly powerful antiseptic actions; the former is excreted in the urine in combination with glycocol as hippuric acid.

Sodium sulphocarbolate, $NaO \cdot C_6H_4 \cdot SO_2OH$, and—

Zinc sulphocarbolate,
$SO_2OH \cdot C_6H_4 \cdot OZnO \cdot C_6H_4 \cdot SO_2OH$, act in much the same way as phenol, but are less toxic.

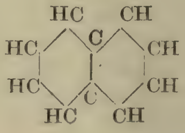
Pyrocatechin, Resorcin and **Hydroquinone,** all with the formula $(OH)_2C_6H_4$, and differing merely in the position in the ring which the OH radicles occupy, and **Guaiacol,** $OH \cdot C_6H_4 \cdot OCH_3$, possess a phenol-like action. Resorcin has been used internally for its antiseptic effect, but is liable to produce dangerous symptoms.

Pyrogallol, $(OH)_3 \cdot C_6H_3$, is used externally only, owing to the toxic effects produced when given internally.

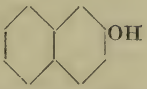
The isomeric **Cresols,** $CH_3 \cdot C_6H_4 \cdot OH$, are efficient antiseptics, less toxic than phenol. They are insoluble in water, but may be suspended by adding a soap.

Creosol, $CH_3 \cdot C_6H_3 \cdot OH \cdot OCH_3$,

Naphthalene,



and its derivative, β-**naphthol,**



are used for their antiseptic actions, naphthalene externally to prevent the destruction of fabrics by moths, and the latter internally, since it is much less toxic than most of the coal tar antiseptics.

Tar, obtained from wood or coal by distillation, possesses a certain antiseptic action which is due to the phenol, naphthalene, pyrocatechin and similar bodies which it contains.

Creosote is obtained from wood tar and contains creosol, cresols, guaiacol, and other phenol derivatives, to which it owes its antiseptic action.

Ichthyol, a tarry liquid obtained by distilling a bituminous substance found in the Tirol, contains about 10 per cent. of sulphur in the form of salts of sulphonic acid.

Lysol and **Jeyes' fluid** are suspensions of cresols.

Chinosol contains a sulphate of oxyquinoline and other sulphates.

Salicylic acid and **salol** have been mentioned under **Antipyretics** (q.v.) as possessing antiseptic actions.

Various **anilin dyes** possess antiseptic actions: they have been used internally for various purposes, particularly for destroying protozoa. **Methylene blue, trypan blue** and **trypan red** contain sulphur in combination; **malachite green** and **methyl violet** have also been used, and more recently **acriflavine** and **proflavine.**

Chrysarobin, a body allied to chrysophanic acid, is obtained from Goa powder (Araroba) and possesses antiseptic and irritant properties. Its antiseptic action is usually made use of in the treatment of chronic skin diseases, to which it is applied in the form of an ointment.

Picric acid, $OH \cdot C_6H_2 \cdot (NO_2)_3$, trinitrophenol, as well as possessing some antiseptic power is an astringent, combining with albumen, and is widely used in the treatment of superficial burns and scalds.

3. **Peroxide of hydrogen,** H_2O_2, **Potassium permanganate,** $KMnO_4$, and **Chromic acid,** CrO_3, owe their antiseptic action to their power of giving off nascent oxygen in the presence of living or putrefactive matter. **Condy's fluid** is a solution of different permanganates.

4. **Formaldehyde,** $H \cdot COH$, and **Formalin** act as antiseptics by reduction. **Hexamethylenetetramine** (syn. Hexamine, Urotropine), is a combination of formalin which, in the presence of acids, sets free this body. It is used largely in the treatment of infections of the urinary tract, and is usually given with acid sodium phosphate to ensure an acid reaction in the urine where the liberation of the formalin is desired.

5. **Boracic acid,** H_3BO_3, and **Borax,** $Na_2B_4O_7$, possess a feeble antiseptic action due to the action of both positive and negative ions.

6. **Charcoal** contains in its pores a quantity of oxygen which it gives up in the presence of putrefactive material, and so it possesses a feeble antiseptic action.

7. **Iodine** is a powerful irritant; it penetrates the tissues fairly readily and forms compounds with albuminous bodies, and thus acts as an antiseptic. On account of its power of penetrating the tissues it is largely used to paint on the skin at the site of an operation, and so there is a chance of the deep as well as the superficial layers of the skin being sterilised. **Iodoform** owes its antiseptic action to its power of giving off free iodine in the presence of putrefying matter.

8. **Chlorine** exerts an antiseptic action by reason of its affinity for water; HCl and free O_2 are formed. Chlorine gas may be freed from bleaching powder and so used to disinfect rooms. Various substances which evolve chlorine have been used as general antiseptics, such as **hypochlorites** (e. g. **eusol), chloramine-T** (sodium toluene sulphonchloramide).

9. **Acids** and **alkalies** (q.v.) have already been mentioned as exerting some antiseptic action from the liberation of H and OH ions respectively.

10. **Volatile oils** possess a mild antiseptic effect on tissues with which they come into contact. On account of their volatility they penetrate tissues readily and so can react on organisms which may lie beneath the surface. Thus the volatile oils of sandalwood, of copaiba and of cubebs are widely used to disinfect the genito-urinary tract, particularly in cases of gonococcal infection; the oil is excreted in the urine and is free to exert its action throughout the urinary tract. The use of hexamine as a urinary antiseptic has already been mentioned. Other methods of sterilising the urinary tract are (a) by flushing out the urinary passages by a simple diuretic (b) by altering the reaction of the urine to a reaction unsuitable for the growth of the particular infesting organism: an acid urine may be made alkaline by exhibiting carbonates, citrates, acetates or tartrates, whilst acid sodium phosphate will render an alkaline urine acid.

ANTITOXINS. See under **Toxins.**

APIOL, a preparation containing the essential oil of parsley. See under **Volatile oils.**

APOCODEINE, an alkaloid formed from **codeine** (see under **Opium**) by abstracting a molecule of water. Its main pharmacological action is one of paralysing ganglion-cells and nerve-endings.

APOCYNUM, Canadian hemp, contains indifferent bodies with a digitalis-like action. See under **Digitalis.**

APOMORPHINE, an alkaloid obtained from morphine by abstraction of a molecule of water. See under **Emetics.**

AQUÆ. See under **Pharmacopœial preparations.**

ARBUTIN and methyl arbutin are glucosides obtained from Bearberry leaves. See under **Diuretics.**

ARECOLINE, an alkaloid obtained from the Areca nut, has a pharmacological action similar to that of **pilocarpine** (q.v.).

ARRHENAL. See under **Arsenic.**

ARSACETIN. See under **Arsenic.**

ARSENIC. Metallic arsenic is insoluble in water, not absorbed from the gastro-intestinal tract and devoid of pharmacological action. The ion, AsO_3, however, dissociated from arsenious acid, is intensely active. **Outside the body** it destroys all forms of life, but is too poisonous for routine use as an antiseptic. Except in very strong solution it is not absorbed through the skin, so long as there is no abrasion or cut through which it can pass. It does not combine with albumen as do the heavy metals. On the **alimentary canal** in small doses arsenic is said to improve the appetite; in large doses it acts as an irritant, producing pain, nausea, vomiting and purging. The stools, after a large dose, resemble the rice-water stools of cholera. Exactly the same effects are produced if the drug is injected; part is excreted into the bowel and this in its passage through the mucous membrane destroys it, and so produces the choleraic condition. There is apparently something of a specific affinity for the cells of the intestinal mucous membrane, since nothing approaching the degenerative changes found here is seen at the seat of injection under the skin. Arsenic produces a marked effect on **metabolism**; there is found a general increase in the breakdown of proteins with an increase in nitrogen excretion in the urine. The blood contains an increased amount of lactic acid. Fatty degeneration occurs in various organs after large doses or after prolonged administration. There is a diminished amount of glycogen in the tissues. If young animals are fed on arsenic, growth, particularly that of bone, is more rapid, and compact bone takes the place of spongy bone. At the same time the bone-marrow is rendered hyperæmic, the increase being in the number of immature white cells and not in the red cells. The **nervous system** is sometimes affected, a peripheral neuritis affecting particularly the extensors of the foot and the opponens pollicis of the hand, being developed. The **cardio-vascular system** is not affected by small doses: later a fatty degeneration of the heart as of other organs may be found. Deposition of pigment and of fat beneath the skin is increased by arsenic. **Tolerance** to arsenic can be established fairly easily (Styrian peasants). In practice it is found that in treating parasitic diseases with arsenical preparations the trypanosomes and spirochætes may very soon become tolerant, if not killed outright by the earlier doses. **Excretion** takes place chiefly in the urine, some by the intestine, the milk and the skin. **Poisoning** by arsenic may be acute or chronic. The acute poisoning is characterised mainly by gastro-intestinal symptoms, followed by collapse and death. Treatment is by continued stomach-lavage with fresh hydrated ferric oxide, demulcents for the injured mucous membrane and stimulants to combat the collapse. Chronic poisoning, as seen in workers in arsenic factories, has symptoms of inflammation of mucous membranes —conjunctivitis, pharyngitis, etc., peripheral neuritis, erythematous or scaly eruptions on the skin with brown pigmentation and frequently intestinal symptoms. Arsenic is used in the treatment of **pernicious anæmia**; it does not increase the number of red blood cells; the suggestion has been made that it may act by destroying a parasite, hitherto undiscovered, which may cause the disease.

Of recent years numerous **organic arsenical compounds** have been tried in the treatment of diseases caused by parasites, such as syphilis, sleeping sickness and malaria. The ideal compound is one which has adequate ionic dissociation in the body and which is strongly parasitotropic and feebly organotropic. As a rule these bodies have no action on trypanosomes in vitro, since there is little or no dissociation under these conditions: in the body, on the other hand, more or less dissociation takes place and the parasite is affected in greater or smaller degree. Since the parasite can become tolerant to arsenic equally with the host, it follows that doses as large as are compatible with safety should be given from the commencement of treatment. Such organic arsenicals are—

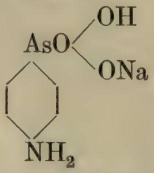
A

1. Cacodyl (Bunsen, 1842), $(CH_3)_2As\text{–}As(CH_3)_2$.
2. Cacodylic acid $(CH_3)_2AsO \cdot OH$.
3. Sodium cacodylate $(CH_3)_2AsO \cdot ONa$.
4. Arrhenal (sodium methylarsinate, new cacodyl), $CH_3AsO(ONa)_2$.

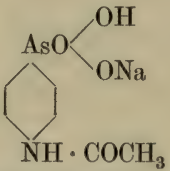
Group A is characterised by little or no dissociation, its members are, therefore, inactive.

B

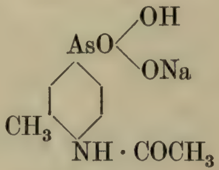
5. Arsinobenzene, $C_6H_5 \cdot AsO_2$.
6. Arsenobenzene, $C_6H_5 \cdot As = As \cdot C_6H_5$.
7. Atoxyl (Béchamp, 1863),



8. Soamine—similar to atoxyl, but contains a different amount of water of crystallisation.
9. Arsacetin (sodium acetyl *p*-arsanilate, acetyl-atoxyl),



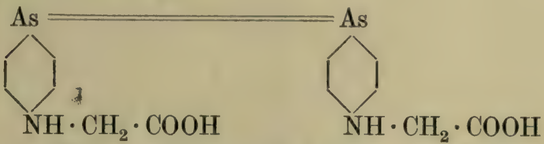
10. Orsudan (sodium methyl acetyl *p*-amino phenyl arsonate).



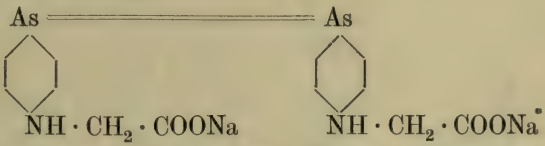
Group B—pentad arsenic—compounds generally relatively strongly organotropic and weakly parasitotropic.

C

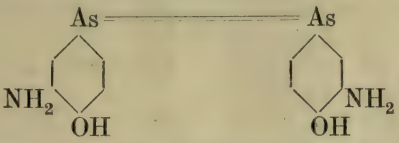
11. Arsenophenylglycin



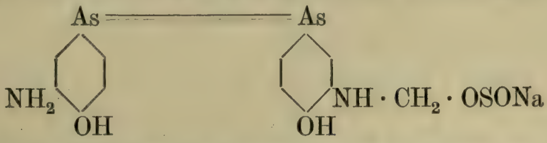
12. Sodium Arsenophenylglycinate (Spirarsyl, "418" of Ehrlich).



13. Salvarsan ("606" of Ehrlich, Kharsivan, Arsenobillon).

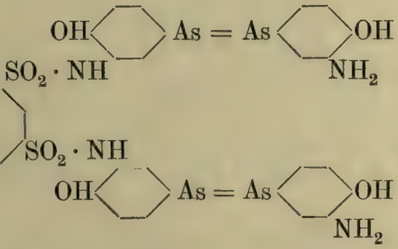


14. Neosalvarsan (Neokharsivan, Novarsenobillon).



15. Galyl—a phosphamic derivative of salvarsan.

16. Ludyl—



17. Luargol—a silver bromide antimony derivative of salvarsan.

The earlier pentad arsenic compounds (group B) were found to be too strongly organotropic; the later triad combinations (group C) are relatively strongly parasitotropic and feebly organotropic. Whereas with the former untoward symptoms culminating in blindness, and even death, were not uncommon, the latter when administered with due precautions give an average of not more than about 0·05 per cent. of minor accidents (albuminuria, jaundice, etc.) attendant on their use.

ARSENOBENZOL. See under **Arsenic.**

ARSENOPHENYLGLYCIN. See under **Arsenic.**

ARTERIES, action of drugs on. See under **Blood-vessels.**

ASAFETIDA, *gr.* 5–15 (0·3–1·0 *Gm.*), a gum-resin obtained from the root of Ferula fetida. See under **Volatile oils.**

ASPIDOSPERMINE, an alkaloid found in the bark of the white **Quebracho** (q.v.).

ASPIRIN, *gr.* 5–15 (0·3–1·0 *Gm.*), syn. Acetyl salicylic acid. See under **Antipyretics.**

ASTRINGENTS, drugs which dry up a part to which they obtain access, may be classified as—

(a) **Vegetable astringents** (catechu, kino, krameria, logwood, hamamelis, gambir), which owe their activity to their **tannic acid** content.

Tannic acid precipitates proteins, gelatin and alkaloids: and it is to this precipitation of protein that the astringent action is due. Taken by the mouth tannic acid attacks the protein not only of such food as may be in the stomach, but of the gastric mucous membrane as well; passing into the intestine, this precipitation of protein goes on until all the tannic acid is decomposed. This precipitation of protein in the body is analogous to the process of tanning—the superficial albuminous bodies are precipitated and so form a covering over the deeper layers which are thus protected. In the same way the ducts of secreting glands may be blocked up and the natural moisture of the part is removed. Tannic acid is changed to **gallic acid** in the intestine; in this form and as gallates and tannates it is absorbed, and is almost completely oxidised in the tissues, only traces being found in either the fæces or the urine. After a dose of tannic acid constipation is produced on account of the dryness of the alimentary canal. If tannic acid is mixed with drawn blood a precipitate is formed, and tannic acid may be used as a local styptic applied directly to a cut.

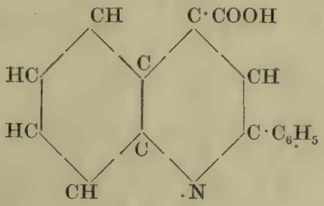
(b) **Mineral astringents.** Salts of the heavy metals have an astringent action due to various causes.

1. Soluble salts form albuminates.

2. A certain amount of local absorption of soluble salts takes place, and so produces a local vasoconstriction from direct action of the metal on the vessel wall.

3. Insoluble salts are deposited, and so form a protective covering to any mucous surface to which they are applied.

ATOPHAN, *gr.* 30–45 (2·0–3·0 *Gm.*), is phenyl quinoline carbonic acid. It has a decided influence in increasing the elimination of **uric acid** from the body; hence it is used in the treatment of gout, which it appears to benefit, though it does not directly influence the pain or inflammation.



ATOXYL. See under **Arsenic.**

ATROPINE, *gr.* 1/200–1/100 (0·0003–0·0006 *Gm.*), an alkaloid obtained from the leaves of Atropa belladonna and from other plants of the Solanaceæ order. Atropine consists of equal parts of dextro- and lævo-rotatory hyoscyamine, the former inactive and the latter intensely active.

Atropine is a **tropeine,** being a combination of **tropine** and **tropic acid.** Tropine is closely allied to Ecgonine, from which Cocaine is derived. **Homatropine** is a synthetic alkaloid obtained by combining tropine with mandelic acid.

General. Atropine first stimulates and then depresses the CNS, where its action is most developed on the motor areas and mid-brain. It also paralyses the nerve-endings of the cranio-sacral autonomic system.

If rubbed into the **skin,** atropine paralyses sensory nerve-endings and the nerve-endings to sweat-glands. In the **mouth** a degree of local absorption occurs, producing dryness of the mouth and pharynx, from paralysis of the secretory nerve-endings in the salivary glands. In the **stomach** motor and secretory nerve-endings are paralysed. **Absorption** takes place rapidly from the stomach and small intestine. Its initial stimulation and secondary depression of the **CNS** produce excitement, restlessness, delirium, mania, and convulsions, followed by drowsiness, sleep, coma and death from respiratory failure, together with certain effects on various viscera referable to central action. The **pupil** is dilated from depression of the nerve-endings of the third cranial nerve; accommodation is paralysed from a similar action on the nerve endings in the ciliary muscle, so that the eye is focussed for distant objects; intraocular tension is increased. The activity of all **secreting glands** is inhibited, the submaxillary gland being affected by paralysis of the chorda tympani nerve-endings, and the sweat-glands by paralysis of sympathetic nerve-endings. Depression of vagal nerve-endings in the **intestine** results in diminution of tonus and inhibition of movements that are of the nature of irregular contractions. Atropine does not cut out centrally-produced impulses from reaching the intestine via the vagus. The **bronchioles** are dilated by atropine, the vagal nerve-endings being paralysed. The **heart** is quickened from the cutting out of tonic vagal inhibitor impulses; it follows that there will be much cardiac acceleration in those animals (such as the dog and adult man) in which there is normally considerable tonic vagal control, and little or no quickening in animals (like the cat and human infants and old people) in which such tonic control is lacking or slight. **Blood-vessels** are constricted, especially in the splanchnic area, whilst cutaneous vessels usually dilate. These effects are centrally produced. Atropine, in common with other drugs that dilate surface vessels, may produce **skin rashes. Blood-pressure** is raised, the resultant of the cardiac and vascular effects. **Respiration** is at first slowed from bronchiolar dilatation, then quickened and rendered deeper from direct medullary stimulation : finally, after poisonous doses respiration is depressed with depression of the medulla. **Body-temperature** is somewhat raised, since increased muscular movements, and probably direct stimulation of the corpus striatum, ensure increased heat formation which usually overcomes the increased heat loss from the dilated surface blood-vessels. The **kidney** is affected indirectly only; cessation of sweating and inhibition of other glands of watery secretion means that more fluid is retained in the organism which the kidneys proceed to excrete. The **mammary** and **thyroid** glands seem to be but slightly, if at all, affected by atropine. Herbivorous animals show a well-developed degree of **tolerance** to atropine; rabbits can feed on belladonna leaves with impunity and to such an extent that their flesh may be poisonous to the less tolerant human being. Children tolerate relatively large doses of atropine. **Excretion** takes place mainly in the urine, some in the milk: it is excreted partly unchanged, partly as tropine.

Atropine may be used in medicine as a stimulant to the CNS in cases of poisoning by central depressants; it is used by some anæsthetists to inhibit the secretion of the bronchial mucous glands prior to anæsthesia by ether. It is used widely in ophthalmic work to procure dilatation of the pupil and paralysis of accommodation. It is incorporated in many purgative pills to prevent griping, and it is a very common remedy for many conditions of spasmodic muscular contraction of the intestine and of other viscera containing plain muscle. It relaxes the bronchial constriction of acute spasmodic asthma, and may be used to quicken the heart in certain cases of bradycardia. A suggestion has been made recently that atropine may be of use as an adjuvant to other methods in the diagnosis of typhoid and paratyphoid infection; there appears to be much less quickening of the heart after atropine in these cases than in the normal or in cases of infection by bacteria of other groups.

BALSAMS, mixtures of **benzoic** and **cinnamic** acids with volatile oils, resins and other aromatic bodies. See under **Volatile oils.**

BARBITONE, *gr.* 5–10 (0·3–0·6 *Gm.*), syn. Veronal. See under **Hypnotics.**

BARIUM, a muscular poison; all forms of muscle are affected and intense increase in tonus results. Its action is a direct one on the contractile substance, the action being unimpaired by previous paralysis of nerve-endings and myoneural junctions with any of the usual depressants, such as apocodeine, ergotoxine, atropine or curare. To a certain extent the action of barium is antagonised by potassium.

BELLADONNA (Deadly Nightshade) contains alkaloids, atropine and hyoscyamine. See under **Atropine.**

BENZAMINE LACTATE, *gr.* $\frac{1}{8}$–$\frac{1}{2}$ (0·008–0·03 *Gm.*), syn. β-eucaine. See under **Cocaine.**

BENZOIN, a balsam obtained from Styrax benzoin. See under **Volatile oils.**

BERBERIS (Barberry) contains a bitter principle. See under **Bitters.**

β-**EUCAINE,** *gr.* $\frac{1}{8}$–$\frac{1}{2}$ (0·008–0·03 *Gm.*), syn. Benzamine lactate. See under **Cocaine.**

β-**IMINAZOLYLETHYLAMINE,** syn. Histamine (ergamine). See under **Amines** and **Ergot.**

β-NAPHTHOL, *gr.* 3–10 (0·2–0·6 *Gm.*). See under **Antiseptics.**

BETEL NUT contains an alkaloid, arecoline, which has similar pharmacological actions to pilocarpine (q.v.).

BISMUTH. See under **Heavy metals.**

BITTERS. Any substance with a markedly bitter taste when taken into the mouth produces reflexes; stimulation of the gustatory nerve-endings producing an increased appetite and an increase in the secretion of gastric juice. Most alkaloids produce this effect, but their more pronounced physiological action in other directions forbids in most cases their use as simple bitters. The usual bitters employed as such in medicine are **gentian, calumba, quassia, bitter orange,** etc.

BLOOD, action of drugs on. Various drugs exert an action on the blood. This action may be in the direction of a change in the number of corpuscles; thus **arsenic** increases the number of leucoblast cells in the bone marrow, **pilocarpine** produces an increase in the number of lymphocytes in the circulation, **colchicine** increases (after an initial diminution in their number) the number of leucocytes circulating in the blood. Or, again, the change may be in the condition of the hæmoglobin: certain coal-tar derivatives, such as **phenacetin** and **acetanilide,** which in the tissues are converted into *p*-amidophenol and similar bodies, convert oxyhæmoglobin into methæmoglobin. **Potassium chlorate** also forms methæmoglobin. **Sulphonal** is liable to produce hæmatoporphyrin. **Carbon monoxide** forms CO-hæmoglobin. If the blood is rendered hypotonic the red cells swell up and become more spherical; if a condition of hypertonicity of the serum is brought about the cells shrink and tend to become crenated.

BLOOD-PRESSURE, action of drugs on. The blood-pressure depends on the state of tonus of the walls of the vessels, particularly of the arterioles, and on the output of blood from the heart. Each of these factors is controlled in man by a very sensitive reflex control mechanism. Thus if for any reason the blood-pressure is raised from vasoconstriction, vagal impulses reach the heart, which is consequently slowed.

Blood-pressure is raised

(a) by drugs which produce **vasoconstriction.**

(b) by drugs which **increase the output of blood from the heart.**

Blood-pressure is lowered

(a) by drugs which produce **vasodilatation.**

(b) by drugs which **diminish cardiac output.**

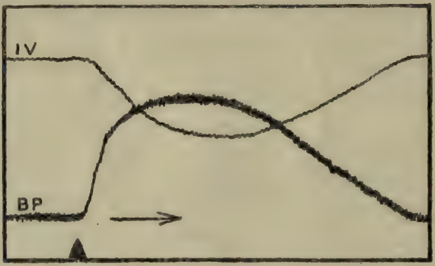


Fig. 1.

The general effect of a drug on blood-pressure may be determined roughly by recording at the same time **arterial blood-pressure,** e. g. by a lever actuated by a mercurial manometer in direct connection with an artery, and the **volume of a viscus,** by enclosing in an oncometer in connection with a recording tambour the spleen or a loop of intestine, isolated with the exception of its blood-vessels, which remain intact. The volume of such a viscus under these conditions simply represents changes in the amount of blood contained in its vessels.

Note.—The graphs in these figures read from left to right. In every case upstrokes of the writing-points register increase in volume and rise in pressure.

Under these conditions four distinct types of tracings may be obtained as the result of giving a drug.

Start here

1. **Blood-pressure rises and intestinal volume diminishes** (Fig. 1). The main effect of the drug must be **vasoconstriction.** If blood-pressure rose on account of increased cardiac output, intestinal volume also would increase; if diminished cardiac output were the cause of the diminution in intestinal volume, blood-pressure would fall. (**Adrenalin, Pituitrin, Barium.**)

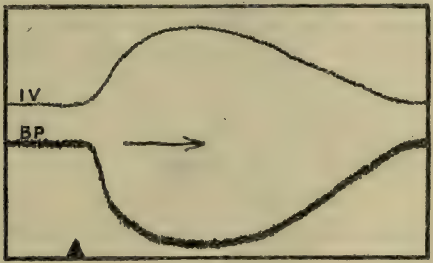


Fig. 2.

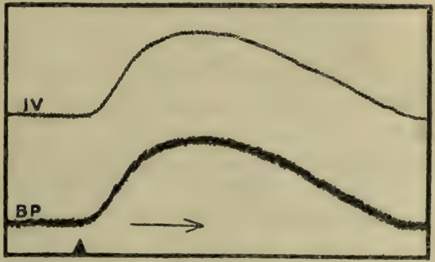


Fig. 3.

2. **Blood-pressure falls and intestinal volume increases** (Fig. 2). The main effect of the drug must be **vasodilatation.** If blood-pressure fell from diminished cardiac output, intestinal volume too would diminish; if the

increase in intestinal volume were due to increased cardiac output, blood-pressure would rise. (**Nitrites.**)

3. **Blood-pressure rises and intestinal volume increases** (Fig. 3). The main effect of the drug must be **increased cardiac output.** If blood-pressure rose from vasoconstriction, intestinal volume would diminish; if intestinal volume increased from vasodilatation, blood-pressure would fall. (**Calcium,** which has a much more important effect on cardiac than on vascular muscle, **Atropine.**) Digitalis does not usually produce this type of tracing; it produces instead the type illustrated in Fig. 1, since, in spite of producing an increase in cardiac output, it produces, too, vasoconstriction, which is usually sufficiently intense to overcome the increased cardiac output, and so to diminish the intestinal volume.

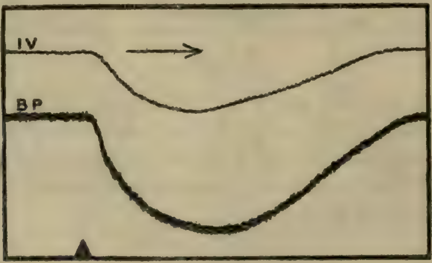


FIG. 4.

4. **Blood-pressure falls and intestinal volume diminishes** (Fig. 4). The main effect must be **diminished cardiac output.** If blood-pressure fell from vasodilatation, intestinal volume would increase; if intestinal volume fell from vasoconstriction, blood-pressure would rise. (**Potassium, Chloroform,** etc., which are more powerfully depressant to cardiac than to vascular muscle; hence the cardiac output is diminished very much and vasodilatation which also occurs is relatively unimportant.)

BLOOD-VESSELS, action of drugs on. The calibre of the vessels may be diminished (**vasoconstriction**)—

(a) reflexly—e. g. by a drug which produces powerful stimulation of sensory nerve-endings, reflex stimulation of the vasoconstrictor centre in the medulla resulting (**Ammonia vapour, Aconitine**);

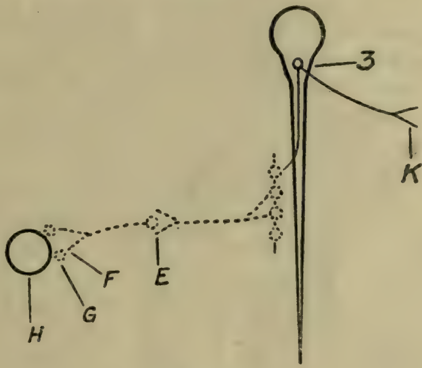


Fig. 5.

K = Sensory nerve-ending in skin or nostrils.
3 = Vasoconstrictor centre in medulla.
E = Ganglion-cell on sympathetic.
F = Nerve-ending on sympathetic.
G = Myoneural junction on sympathetic.
H = Plain muscle of arteriole.

Drugs acting on K.—Ammonia vapour, sudden application of heat or cold, etc. + Aconitine +

Drugs acting on 3.—Atropine + (−), strychnine +, digitalis +, chloroform −, HCN + −, etc.

Drugs acting on E.—Nicotine + −, etc.

Drugs acting on F and G.—Adrenalin +, ergotoxine + −, tyramine +, (pilocarpine +), apocodeine −, etc.

Drugs acting on H.—Barium +, pituitrin +, digitalis +, chloroform −, nitrites −, etc.

(b) by drugs which directly stimulate the vasoconstrictor centre (**Cocaine, Atropine, Strychnine, HCN**);

(c) by drugs which stimulate sympathetic ganglion cells (**Nicotine**, etc.);

(d) by drugs which stimulate sympathetic "nerve-endings" (**Adrenalin, Ergotoxin, Tyramine**);

(e) by drugs which directly stimulate the musculature of the blood-vessels (**Barium, Lead, Pituitrin, Digitalis**).

The calibre of the vessels may be enlarged (**vasodilatation**)—

(a) by drugs which depress the vasoconstrictor centre (**Chloroform, HCN**—in large doses);

(b) by drugs which depress sympathetic ganglion-cells (**Nicotine**—in large doses);

(c) by drugs which depress sympathetic "nerve-endings" (**Ergotoxine**—in large doses—**Apocodeine**);

(d) by drugs which directly depress the musculature of the blood-vessels (**Nitrites, Potassium, Chloroform**).

The most noticeable effects of drugs on vessels are produced on the arterioles; but there is reason to believe that certain drugs possess, in addition, a marked effect on capillaries (adrenalin, histamine).

Certain vessels—e. g. the coronary, pulmonary, cerebral —possess a vasomotor innervation which is either so slight as to be of no value for practical purposes, or no vasomotor innervation at all, or a vasomotor innervation which is peculiar in that the dilator fibres predominate over the constrictor; such vessels, as one would expect, show different reactions to drugs like adrenalin, which exert their action on the whole of the vasomotor "nerve-endings," irrespective of their function. Thus adrenalin, under certain conditions, may dilate the coronary vessels, and produce no effect on the pulmonary and cerebral, though other vessels are powerfully constricted by it.

omit

BORACIC ACID, *gr.* 5–15 (0·3–1·0 *Gm.*). See under **Antiseptics.**

BORAX, *gr.* 5–15 (0·3–1·0 *Gm.*), syn. Sodium biborate. See under **Antiseptics.**

BORIC ACID, syn. Boracic acid (q.v.).

BORNEOL, *gr.* 2–5 (0·1–0·3 *Gm.*), a stearoptene. See under **Volatile oils.**

BROMAL HYDRATE, $CBr_3CH(OH)_2$, *gr.* 2–5 (0·12–0·3 *Gm.*). See under **Hypnotics.**

BROMIDES. Beyond a slight and negligible salt action, the bromides exert their pharmacological action by reason of a specific affinity which they possess for the cells of the CNS. The whole of the CNS is depressed equally and at the same time. Reflexes are diminished from an action on the cord; respiration is slower from medullary depression; the effects on the motor areas and higher centres are shown by diminution of muscular movements and by sluggish cerebration and impaired association of ideas. After large doses or prolonged administration an actual degeneration of cortical cells may be demonstrable. Various other symptoms, grouped under the term **bromism,** are sometimes seen; these are probably referable to irritation of mucous membranes during excretion, small amounts of bromine being liberated. Thus catarrh and inflammation of the conjunctiva, the mucous membrane of the nose, mouth, pharynx, bronchioles and gastro-intestinal tract, together with acneiform skin eruptions, are of common occurrence. The bromides of sodium, potassium and ammonium are used in medicine in doses of *gr.* 5–30 (0·3–2·0 *Gm.*).

BROMINE is a very volatile fluid with an intensely irritant action on all tissues. It has a strong affinity for hydrogen, and so in the presence of water exerts an antiseptic action.

BROMOFORM, $CHBr_3$, ♏ $\frac{1}{2}$–2 (0·03–0·12 c.c.). See under **Hypnotics.**

BRONCHIOLES, action of drugs on. As far as the action of drugs is concerned the bronchioles may be regarded as tubes of circular plain muscle lined with an epithelium containing secreting mucous glands. The plain muscle is innervated by the vagus (constrictor) and by the sympathetic (dilator). **Broncho-constriction** may be brought about by any drug which directly stimulates plain muscle (barium), or by any drug which stimulates any part of the vagal innervation (pilocarpine). Similarly **broncho-dilatation** results from depression of the plain muscle (nitrites), stimulation of the sympathetic (adrenalin) or depression of the vagal innervation (atropine). The vagus contains secretory fibres to the mucous glands as well as broncho-constrictor fibres, so that pilocarpine produces a great increase in the secretion of bronchial mucus as well as broncho-constriction. Similarly atropine

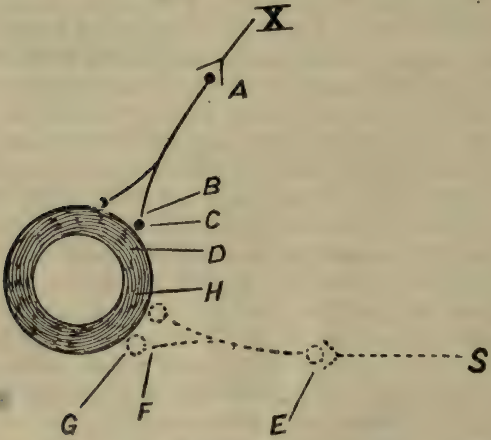


FIG. 6.

A = Ganglion-cell on the vagus (X), (broncho-constrictor).
B = Nerve-ending of the vagus.
C = Myoneural junction of the vagus.
D = Plain muscle of bronchiole, supplied by X.
E = Ganglion-cell on sympathetic (S), (broncho-dilator).
F = Nerve-ending on sympathetic.
G = Myoneural junction on sympathetic.
H = Plain muscle of bronchiole, supplied by S.

Drugs acting on A and E.—Nicotine + −, lobeline + −, etc.

Drugs acting on B and C.—Pilocarpine +, atropine −, etc.

Drugs acting on D and H.—Barium +, nitrites −, chloroform −, histamine +, etc.

Drugs acting on F and G.—Adrenalin +, (pilocarpine +), ergotoxine + −, etc.

dries up the secretion as well as producing broncho-dilatation. These bronchial mucous glands are also affected reflexly. See under **Expectorants.** Broncho-constriction frequently produces a condition analogous to acute spasmodic asthma; the bronchioles are so tightly constricted that a great resistance is offered to the passage backwards and forwards of an adequate amount of air with each respiratory movement. The inspiratory muscles are stronger than the expiratory, so that the chest becomes progressively fuller of air which it cannot expel during expiration. See also under **Respiration.**

BRUCINE, an alkaloid found with strychnine in nux vomica beans. See under **Strychnine.**

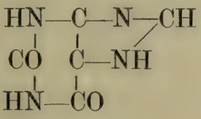
BUCHU, the leaves of Barosma betulina, contains a volatile oil which has a feeble diuretic and antiseptic action. See under **Volatile oils** and **Diuretics.**

BUTYL CHLORAL HYDRATE, $C_3H_4Cl_3CH(OH)_2$, *gr.* 5–20 (0·3–1·2 *Gm.*). See under **Hypnotics.**

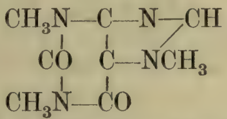
CACAO, syn. Cocoa. See under **Diuretics** and **Caffeine.**

CACODYLIC ACID. See under **Arsenic.**

CAFFEINE, *gr.* 1–5 (0·06–0·3 *Gm.*), an alkaloid found in tea, coffee and other plants. Caffeine is a derivative of **purin.**



Xanthine



Trimethylxanthine (Caffeine)

Theobromine and **Theophylline** are allied bodies, being isomeric dimethylxanthines.

Caffeine is absorbed readily from the small intestine and produces no noteworthy action during absorption. Whilst in the circulation it exerts a marked action on

1. the CNS;
2. all forms of muscle;
3. the kidney.

The **CNS** is stimulated without any secondary depression. The action is most noticeable on the **higher centres**; thought and the association of ideas are rendered easier and the feeling of fatigue is abolished or lessened. This action is totally different from that of alcohol (q.v.). The actions of the two drugs may be exemplified by taking two types of student with a viva-voce examination before them. The student who knows his work well but who suffers from a paralytic nervousness on such occasions (over-action of the higher control centres) may do himself greater justice if he first depresses his control centres with a small dose of alcohol: on the other hand, the student who does not know his work, and who trusts to being able to think out his problems on the spot, would be in a hopeless position after alcohol, but might be enabled to reason things out more successfully after a small dose of caffeine. It should be pointed out that from the student's point of view certain awkward symptoms are liable to obtrude themselves after too large a dose of either drug! Large doses of caffeine stimulate also the motor areas and medulla with consequent restlessness, increase of movements, stimulation of respiration and vasoconstriction; and after very large doses even increased reflexes from stimulation of the cord. A rise in **body-temperature** is usually found (1) from stimulation of the corpus striatum; (2) secondary to the increase in muscular movements.

All forms of **muscle** are affected by caffeine; striped muscle is at first rendered more irritable and capable of contracting to greater effect as the result of a given stimulus; finally, it goes into a state of rigor. The **heart** is quickened from a stimulant effect of the drug on the excito-motor area, large doses render the whole of the cardiac muscle hyperirritable, so that fibrillary twitchings and idioventricular rhythm may occur. **Plain muscle** too, particularly that of the arterioles, is affected, so that as a result of perfusing caffeine through blood-vessels vasodilatation results. **Blood-pressure** rises (a) from increased cardiac output; (b) from centrally produced vasoconstriction, which in the case of most vessels overcomes the peripherally produced vasodilatation. The **kidneys** are affected so that a considerable increase in diuresis takes place, either in health or in disease. (Cf. Digitalis.) It has been shown that the cardiac output is increased and that there is a general tendency to vasoconstriction from medullary stimulation, whilst the local action of the drug on the arterioles is to produce dilatation. The renal vessels are less well innervated than most, so that the central vasoconstriction passes off sooner in the case of these than in the case of the other splanchnic vessels; in other words the kidney vessels dilate at a time when the blood-pressure is still high and other vessels remain constricted—in consequence, more blood flows through the kidney than normally, and ideal conditions for a copious diuresis are established. An increase in the oxygen consumption of the kidney is found during caffeine diuresis, and this point has been considered to be evidence in favour of a direct action of the drug on the renal cells. Caffeine is **excreted** in the urine, partly unchanged and partly broken down as *di-* and *mono*-methylxanthine, as purin and as urea. See also under **Diuretics.**

CAJUPUT OIL, ♏ $\frac{1}{2}$–3 (0·03–0·18 c.c.). See under **Volatile oils.**

CALABAR BEAN, syn. Ordeal bean, contains an alkaloid, **physostigmine** (q.v.).

CALAMINE, an impure preparation of zinc oxide. See under **Heavy metals.**

CALCIUM, a normal constituent of animal tissues, especially of bone. A certain small amount of calcium is necessary for the life of all such tissues (a saline solution without a trace of calcium is not capable of keeping an isolated organ functioning). If young animals are fed on a diet poor in calcium their bones grow only to a small size, but such bone as is formed has a normal calcium content. (Cf. Rickets.)

Calcium is **absorbed** with difficulty from the alimentary canal; absorption is rendered easier by the presence of fats, a more readily absorbable calcium soap being formed. Calcium possesses a specific affinity, like that of barium, for all forms of **muscle**; the contraction of striped muscle in response to a given stimulus is increased; the tonus of plain muscle is raised; cardiac muscle contracts with greater force, if somewhat more slowly, and after poisonous doses comes to a standstill in systole. The presence of calcium is necessary for the activation of **ferments**; whilst diapedesis of leucocytes and inflammatory processes are inhibited by it. The **metabolism** of calcium appears to be bound up intimately with the functioning of the **pituitary** gland. When the latter is in a state of hypofunction (dystrophia adiposo genitalis), calcium is not retained in the organism; when the pituitary is in a state of hyperactivity (acromegaly, pregnancy), calcium is retained. **Excretion** takes place in the urine and by the large intestine.

CALOMEL, Hg_2Cl_2, *gr.* $\frac{1}{2}$–5 (0·03–0·3 *Gm.*). See under **Purgatives** and **Mercury.**

CALUMBA. See under **Bitters.**

CAMBOGE, syn. Gamboge, *gr.* $\frac{1}{2}$–2 (0·03–0·1 *Gm.*). See under **Purgatives.**

CAMPHOR, *gr.* 2–5 (0·12–0·3 *Gm.*), a stearoptene. See under **Volatile oils.**

CANADIAN HEMP, syn. Apocynum, contains principles with a digitalis-like action.

CANNABIS INDICA, Indian hemp, hashish, bhang, contains an oily substance, cannabinol, which has a profound action on the **CNS,** apparently a depressant effect rather like that of alcohol, which affects the higher centres first and works downwards. Much the same symptoms are found as after alcohol, in addition hallucinations of various kinds are common.

CANTHARIDES, syn. Spanish fly. See under **Irritants**

CAPSICUM, syn. Chillies. See under **Volatile oils.**

CARAWAY. See under **Volatile oils.**

CARBOLIC ACID, syn. Phenol, *gr.* 1–3 (0·06–0·2 *Gm.*), C_6H_5OH. See under **Antiseptics, Anæsthetics (local).**

CARBONATES. See under **Alkalies.**

CARDAMOMS. See under **Volatile oils.**

CARMINATIVES. See under **Volatile oils.**

CARUI FRUCTUS, syn. Caraway. See under **Volatile oils.**

CARYOPHYLLUM, syn. Cloves. See under **Volatile oils.**

CASCARA SAGRADA. See under **Purgatives.**

CASSIA PULP. See under **Purgatives.**

CASTOR OIL. See under **Purgatives.**

CATECHU. See under **Astringents.**

CENTRAL NERVOUS SYSTEM, action of drugs on. A wide variety of drugs acts directly on one part or another of the CNS. The general **anæsthetics** and the **hypnotics,** together with **morphine** and **cannabis indica,** directly depress the whole of the CNS from above downwards; **physostigmine** depresses in the reverse order. Certain other drugs, such as **caffeine, ammonium, strychnine** and **apomorphine,** directly stimulate it. Yet a third group of drugs depresses after an initial stimulation, e. g. **cocaine, atropine, hyoscyamine, hyoscine, aconitine** and **prussic acid.** Whilst, generally speaking, these centrally acting drugs affect the whole of the CNS, certain of them act much more strongly on some parts than on others, e. g. the action of caffeine on the higher centres and that of strychnine on the cord and medulla. (See diagram under **Seats of action of drugs.**)

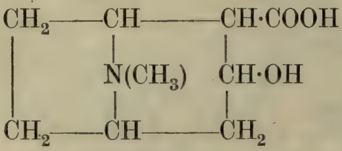
CEPHÆLINE, an alkaloid found in **Ipecacuanha.** See under **Emetics.**

CERA, syn. Wax. See under **Pharmacopœial preparations.**

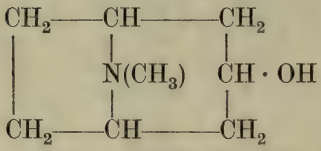
CETACEUM, syn. Spermaceti. See under **Pharmacopœial preparations.**

CHARCOAL. See under **Antiseptics.**

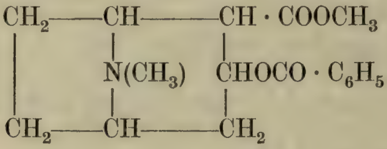
CHEMICAL CONSTITUTION AND PHARMACOLOGICAL ACTION. The idea that the pharmacological action of a given substance can be foretold from a consideration of its chemical structure is not tenable; too many unknown factors come into play. To a certain extent and with certain groups of drugs there is a very definite similarity; thus certain amines (q.v.) similar in structure possess remarkably similar actions. Again it is found that **ecgonine**



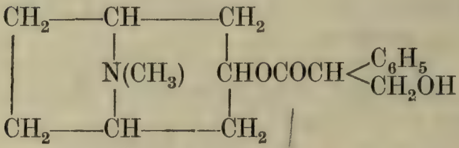
and **tropine**



possess little or no action on nervous tissue, whilst addition of methyl and benzoyl radicles to the one and a tropic acid (or mandelic acid) radicle to the other form bodies, **cocaine**



and **atropine**



(or homatropine), bodies which possess a very distinct effect on nerve-tissues. Other examples of a corresponding similarity cannot fail to strike the student; but however interesting such similarities may be, little or no practical importance can at present be attached to them; sooner or later the theory breaks down.

CHINOSOL, *gr.* 1–5 (0·06–0·3 *Gm.*). See under **Antiseptics.**

CHLORAL HYDRATE, $CCl_3CH(OH)_2$, *gr.* 5–20 (0·3–1·2 *Gm.*). See under **Hypnotics.**

CHLORALAMIDE, $CCl_3CH \cdot OH \cdot NH \cdot COH$, *gr.* 15–45 (1–3 *Gm.*). See under **Hypnotics.**

CHLORALOSE, anhydrous glyco-chloral, *gr.* 3–10 (0·2–0·6 *Gm.*). See under **Hypnotics.**

CHLORATES are absorbed rapidly from the gastro-intestinal tract and circulate for the most part unchanged (formerly it was thought that they were reduced in the tissues with liberation of free O_2) in the blood. They exert an action on the **blood,** converting hæmoglobin into methæmoglobin, with some destruction of corpuscles in large doses. Most of the toxic symptoms in cases of poisoning are due to the formation of methæmoglobin—cyanosis, scanty dark urine, inefficient respiration and death from asphyxia. Excretion takes place rapidly in the urine, saliva, bronchial mucus, sweat and milk. Use is made of the fact that part of the dose is excreted in the saliva and of the fact that in the presence of septic matter oxygen is set free, in the treatment of septic sore throat and allied conditions. The affected part is kept bathed with a dilute solution of chlorate which during excretion keeps the septic part supplied with a steady stream of nascent oxygen. See also under **Antiseptics.**

CHLORETONE, trichlortertiarybutylalcohol, *gr.* 5–24 (0·3–1·5 *Gm.*). See under **Antiseptics** and **Hypnotics.**

CHLORIDES form the bulk of the normal body salts and have no specific actions, being inert as ions. In bulk chlorides, as other salts, produce an osmotic action which is of comparatively short duration owing to rapid excretion.

CHLORINE is a powerfully irritating gas with a strong affinity for hydrogen, by virtue of which property it acts as an antiseptic in the presence of water. See under **Antiseptics.**

CHLOROFORM, $CHCl_3$, ♏ 1–5 (0·06–0·3 c.c.), applied to the **skin** chloroform is a rubefacient and irritant. In the **stomach** it is irritant and well diluted may be taken for its carminative action. Owing to its volatility it is very rapidly **absorbed** into the circulation either from the alimentary canal or by inhalation from the respiratory tract. It depresses the whole of the **CNS** from above downwards, acting like alcohol. Further it is a powerful depressant to all forms of **muscle,** weakening the force of cardiac contraction and dilating the blood-vessels, whilst the tonus and activity of other forms of plain muscle are similarly depressed. However administered, **excretion** takes place mainly by the lungs, a small amount only being oxidised in the tissues. In certain individuals profound metabolic changes are met with following prolonged administration of chloroform; glycuronic acid is found in the urine, a great increase in the amino acids of the urine is seen, together with fatty degeneration of the liver and sometimes of the kidney and heart.

All the immediate pharmacological actions of chloroform may be ascribed to either (1) reflex actions set up by the stimulant action of the drug on mucous membranes, (2) direct action on the CNS, or (3) direct action on muscle. Thus early in the administration of chloroform one finds reflex effects together with those symptoms referable to depression of the highest centres of the brain, then symptoms referable to general depression of the functions of the fore- and mid-brain, later depression of the medulla as well as of the brain, and direct depression of cardiac and vascular muscle. The actual symptoms produced will depend largely on the concentration of the drug reaching the circulation and on the duration of the administration. To take an example, the heart may be quickened as one of the earlier reflex effects: it may be seriously slowed, or completely inhibited by a strong concentration of chloroform vapour suddenly inhaled, the effect of which is that the medulla—freed from the restraining influence of the higher centres—is hyper-excitable, and a stimulus, normally capable of producing but negligible effects, may initiate such powerful impulses down the vagus as to stop the heart completely; yet, again, after prolonged administration symptoms referable to the directly toxic action of the drug on the heart muscle may be in evidence—feeble cardiac contractions with chambers engorged with blood which the weak contractions are unable to expel. See also under **Anæsthetics.**

CHOLAGOGUES. The cholagogue purgatives, so called, are not true cholagogues for the most part. A true cholagogue is a substance which stimulates the secretion of bile, and this the ordinary purgative does not do. What the purgative does is to hurry the intestinal contents through the intestine, giving insufficient time for the normal absorption and destruction of biliary constituents, so that the fæces, as passed, contain a large amount of unchanged bile. Drugs which produce a genuine increase in the amount of bile secreted are **Bile-salts, Salicylic** and **Benzoic acids, Turpentine,** and perhaps **Podophyllin** and **Euonymus.**

CHOLINE, $OH \cdot N(CH_3)_3 \cdot CH_2CH_2OH$, a constituent of animal tissues with a close similarity to **muscarine** both in chemical constitution and in pharmacological action.

CHROMIC ACID. See under **Antiseptics.**

CHRYSAROBIN. See under **Antiseptics.**

CHRYSOPHANIC ACID. See under **Purgatives** (anthracene).

CINCHONA BARK contains **quinine** and other alkaloids. See **Quinine** under **Antipyretics.**

CINNAMON. See under **Volatile oils.**

CITRATES are absorbed from the gastro-intestinal tract rather slowly, and so in adequate dose may produce a purgative effect from salt action. After absorption the citrates are converted into **carbonates** in the tissues and excreted in this form in the urine, which is thus rendered alkaline. Citrates combine with calcium, and so if added to blood prevent or hinder clotting; they are sometimes used for this purpose in laboratory experiments—e. g. in a cannula tied into a blood-vessel.

COAL-TAR DERIVATIVES. See under **Antiseptics** and **Antipyretics.**

COCAINE, *gr.* 1/20–½ (0·003–0·03 *Gm.*), syn. Methyl benzoyl ecgonine (see under **Chemical constitution and pharmacological action**), an alkaloid obtained from coca leaves (Erythroxylon coca) along with certain other alkaloids and some tannic acid. Cocaine is a **general protoplasmic poison.** Applied to the **skin** it produces no effect, since it is not absorbed. Local application to a mucous membrane results in some absorption and local anæsthesia is produced. It is **absorbed** readily from the small intestine and whilst circulating in the blood produces effects on (1) the CNS; (2) nerve-endings. The **CNS** is first stimulated and then depressed; the action starts in the higher centres and works downwards, so that at a certain stage of the action the higher control centres are depressed whilst the motor areas are being stimulated. This results in wild excitement and hilarity—a condition resembling superficially that produced by alcohol, but whereas alcohol merely sets free the more automatic centres from the normal control of the higher centres, cocaine stimulates at the same time. Later stimulation of the medulla and cord results in more active respiratory movements, increased reflexes and so on. Death ensues after toxic doses from paralysis of the respiratory centre.

Most of the other effects of cocaine are referable to its action on nerve-endings; the **pupil** is dilated, the **heart** is quickened and the force of its beat is increased, both effects being due to stimulation of sympathetic nerve-endings. **Vasoconstriction** is produced partly from central stimulation and partly from stimulation of sympathetic nerve-endings. **Blood-pressure** is raised as a resultant of the cardiac and vascular effects. A cocaine **habit** is usually started on account of the stimulating effect which the drug produces at first on the cerebral cortex; the natives of South America chew coca leaves on account of the fatigue-dispelling properties. There seems reason for the belief that in modern times habits have been started by certain "tonic" wines containing cocaine. The victim of the cocaine habit is in no better case, frequently, perhaps, in worse, than the victim of other drug habits. See also under **Habits.**

Sensory nerve-endings are depressed, producing **anæsthesia,** wherever the drug comes into contact with them, either as a result of local application or following general administration. The local anæsthetic effect is often desired, whilst the general action is not sought after in legitimate medicine. So one finds that cocaine is administered in medicine only by local application, and this is brought about either by a true local injection under the skin or by subdural injection to produce spinal anæsthesia. In either case nerve-trunks or nerve-endings are depressed locally and so the anæsthesia is produced. As well as local anæsthesia a small degree of local vasoconstriction is obtained. In order to prevent any spread of the drug from the site of application or injection, adrenalin is frequently injected or applied along with it; this by inducing an intense vasoconstriction so far stops the local circulation that the cocaine is confined to the spot and produces no general effects. It should be pointed out that in the case of a mixed nerve the afferent fibres are paralysed before the efferent.

Of recent years endeavours have been made to find a substitute for cocaine; the ideal drug would be one which combines the minimum of general toxicity with but slight initial stimulant effect on sensory·nerve-endings and the maximum of depressant effect on these nerve-endings. Such substitutes are **Eucaine, Tropacocaine, Stovaine, Alypin, Novocaine, Nirvanine, Holocaine.** These bodies are similar to cocaine in chemical composition; with the exceptions of novocaine and holocaine, all are much more irritant than cocaine, and of these two holocaine possesses about twice the anæsthetic power with half the general toxicity of cocaine, whilst novocaine is weaker than cocaine in both respects.

Other drugs which depress sensory nerve-endings are phenol, aconitine, veratrine, prussic acid, whilst freezing the part—as by a fine spray of ethyl chloride or ether—produces the same effect.

COCOA, obtained from Theobroma cacao, contains the alkaloid theobromine (q.v.). The student should on no account confuse **coca** with **cacao**; theobroma (the food of the gods) is a name which by no stretch of the imagination could be applied to a substance which, like coca, contains the alkaloid cocaine.

CODEINE, *gr.* ¼–2 (0·016–0·12 *Gm.*), an alkaloid obtained from **Opium** (q.v.).

COD LIVER OIL, ʒ 1–4 (4–15 c.c.), a fixed oil obtained by extraction from the liver of the cod (Gadus morrhua), is used in medicine as a food rather than as a drug. The chief reasons for its use are that it is more readily emulsified and more readily digested and absorbed than most fixed oils. It is used very widely in the treatment of tuberculosis and other conditions where an easily assimilable food is essential.

COFFEE, contains an alkaloid, **caffeine** (q.v.).

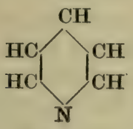
COLCHICINE, *gr.* 1/100–1/32 (0·0006–0·002 *Gm.*), an alkaloid found in the colchicum corm, has an action similar to that of pilocarpine (q.v.), but is considerably weaker than that drug. In addition to its pilocarpine-like action colchicine produces a distinct leucocytosis after an initial fall in the number of circulating leucocytes. Further some hours after administration of a large dose a secondary action takes place, sensory and motor nerves becoming paralysed and death following from respiratory paralysis. A similar latent period is seen before this secondary action no matter whether the drug is given by mouth or by intravenous injection. Probably this secondary action is referable to **oxycolchicine,** to which some of the colchicine is changed in mammalian tissues. If colchicine is injected into a frog, no oxycolchicine is formed and none of these secondary effects is seen, but oxycolchicine produces similar effects on frog and mammal.

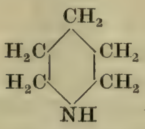
Colchicum has been used in the treatment of **gout.** The method of action is unknown; colchicum does not affect the excretion of uric acid.

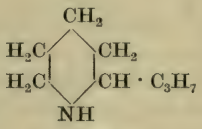
COLOCYNTH, *gr.* 2–8 (0·12–0·5 *Gm.*), the dried pulp of the bitter apple, citrullus colocynthis. See under **Purgatives.**

CONFECTIONES. See under **Pharmacopœial preparations.**

CONIINE, *gr.* 1/3–2 (0·02–0·12 *Gm.*), a liquid alkaloid obtained from hemlock, conium maculatum. Coniine is closely allied to **piperidine.**


Pyridine


Piperidine


Coniine

The action of coniine is similar to that of **curare** in that it paralyses motor nerve-endings, and like that of **nicotine** in that it first stimulates and then paralyses ganglion-cells. See also under curare and nicotine.

CONVALLARIA, lily of the valley, contains a glucoside of the digitalis series. See under **Digitalis.**

COPAIBA. See under **Volatile oils.**

COPPER SALTS. See under **Heavy metals.**

CORIANDER. See under **Volatile oils.**

CREOSOTE. See under **Antiseptics.**

CRESOL. See under **Antiseptics.**

CRESYLIC ACID. See under **Antiseptics.**

CRETA, chalk. See under **Pharmacopœial preparations.**

CROTIN, a vegetable toxin contained in the seeds of Croton tiglium. See under **Toxins.**

CUBEBS. See under **Volatile oils.**

CUPREINE, an alkaloid found along with quinine (= methyl cupreine) in cuprea bark, remijia pedunculata, has pharmacological actions similar to those of **quinine** (q.v.).

CURARE, obtained from the bark of strychnos toxifera, and used by South American natives as an arrow-head poison, contains various alkaloids of which **curarine** is the most important. The chief action of curare is one of paralysing motor nerve-endings in muscle. It acts much more powerfully on the nerve-endings to striped muscle than on others. Large doses paralyse too sympathetic ganglion cells. Curare is excreted unchanged by the kidney. If taken by the mouth, very large doses can be taken without producing physiological effects, which are shown only when the drug is injected intravenously or subcutaneously. Death is caused by the failure of the impulses sent out by the medulla to reach the diaphragm and other muscles concerned, so that respiration ceases and asphyxia ensues. Curare probably has some slight depressant action on the CNS, but compared with the peripheral action this is negligible.

CUSSO, ℥ $\frac{1}{4}$–$\frac{1}{2}$ (8–16 *Gm.*). See under **Anthelmintics.**

DATURA STRAMONIUM, thornapple, contains the alkaloids atropine, hyoscyamine and hyoscine. See under **Atropine.**

DEADLY NIGHTSHADE, atropa belladonna, contains atropine and hyoscyamine. See under **Atropine.**

DECOCTA. See under **Pharmacopœial preparations.**

DEMULCENTS. Substances which soothe and protect from irritation mucous and inflamed surfaces. They act mainly by physical means, sticking to the surface to which they are applied and so forming a covering to it. The bodies usually used as demulcents are **tragacanth** and

acacia, linseed and **starch, liquorice, marshmallow, sweet almonds** and **gelatin.** The action of the insoluble salts of some of the heavy metals is essentially similar, but for convenience these are usually classified under astringents.

DIAMORPHINE, syn. Heroine, *gr.* 1/25–⅛ (0·0025–0·008 *Gm.*). See under **Opium.**

DIGALEN, an aqueous glycerin solution of certain of the active principles of digitalis—probably digitoxin and digitalein. See under **Digitalis.**

DIGIPURATUM is said to contain 95 per cent. of the active principles of digitalis after the removal of 85 per cent. of saponins and inert matter. See under **Digitalis.**

DIGITALEIN. See under **Digitalis.**

DIGITALIN. See under **Digitalis.**

DIGITALIS. The leaves and seeds of Digitalis purpurea as well as the seeds of **strophanthus,** the bulbs of Scilla maritima (**squills**), and various less commonly used plants, such as acocanthera, apocynum, heleborus niger, convallaria majalis, contain a group of active principles, mostly **glucosides,** which are characterised by an action on the **heart.** These bodies are frequently known as the group of cardiac tonics or cardiac glucosides.

Digitalis contains **digitoxin,** a highly irritant glucoside which produces all the pharmacological actions of digitalis, **digitonin,** a saponin, **digitalin,** possessing the actions of digitoxin in rather less marked degree and much less irritant, and **digitalein.**

Strophanthus contains the glucoside, **strophanthin.**

Squill contains amorphous glucosides **scillitoxin, scillipicrin.**

All these glucosides are liable to break down into resin-like bodies which are toxic; also they are very easily destroyed by intestinal ferments. Thus comparatively small proportions of doses given by mouth are absorbed unchanged from the gastro-intestinal tract, and it is of importance that preparations should be freshly prepared and standardised.

In the **stomach** digitalis is irritant and is liable to give rise to nausea and vomiting, and later to diarrhœa. (Euonymus, a member of the digitalis group, is used solely for its purgative effect.) **Absorption** takes place but slowly from the small intestine: when given by the mouth effects on the heart are not usually obtained inside forty-eight hours. The **CNS** is stimulated, the effects referable to medullary stimulation being the most noticeable—slowed heart, deeper respiration, vasoconstriction. The **heart** is slowed, and the force and amplitude of its beat are increased. This is brought about (a) by direct stimulation of cardiac muscle (= slowing and increased amplitude); (b) by stimulation of vagal centre in the medulla (= slowing); (c) by stimulation of vagal nerve-endings in the heart (= slowing). The slowing is mainly diastolic; the lengthened diastolic pause results in a more complete filling of the chambers with blood whilst the heart is relaxed, and the more powerful contraction ensures a more complete emptying of the heart at each systole. Thus the output of blood from the heart is very decidedly increased. This enables more blood to circulate through the coronary vessels, and in consequence there is improved nutrition of the cardiac muscle. In yet another respect is the heart affected: digitalis acts directly on the conductile tissue and diminishes the conductivity, so that in certain cases in which the heart is beating very rapidly digitalis may be used to block the conductile tissue, and so produce a slower and independent ventricular rhythm, thus saving the ventricles from an ineffective and unduly rapid action, which would result in complete fatigue unless checked. These effects, which may be regarded as the therapeutic action of the drug, may be seen in the normal heart; but if to start with the heart is pathological—e. g. in a case of uncompensated mitral regurgitation or in auricular fibrillation—the effects of the drug are naturally magnified. If the administration of digitalis is unduly prolonged, or if too large a concentration reaches the heart, these therapeutic and beneficial effects give place to a poisonous action, which is usually characterised by three stages: (1) The vagal action predominates and the heart beats very slowly, so that the output of blood per minute falls; (2) the heart muscle becomes very irritable, so that the beats are very irregular with arrhythmia between auricle and ventricle, and later (3) fibrillary twitchings or delirium cordis, in which the output of blood sinks to zero and the heart dies in extreme systole. Digitalis increases the tonus of heart muscle; in small degree this may be an advantageous change, particularly when the heart is flabby and tends to become overdistended with blood; but beyond a certain point this increase in tonus is not an advantage, as, if the tonus is so much increased that the heart fails to relax sufficiently in diastole, less blood is taken in at each relaxation and so the output may be impaired. It will be realised that there is in many respects a similarity between the action of digitalis and that of **barium.** The **blood-vessels** are constricted by digitalis; this results (1) from stimulation of the medulla and (2) from direct action on the vascular muscle. **Blood-pressure** is raised as the resultant of the cardiac and vascular effects. A certain school of clinicians has recently asserted dogmatically that digitalis does not raise the blood-pressure and that it does not cause vasoconstriction. It can be shown in the laboratory that digitalis certainly does raise the pressure and that it certainly does produce vasoconstriction. If simultaneous records of blood-pressure and of the volume of a viscus are taken (see also under **Blood-pressure**), the usual effect of digitalis is to raise the pressure and to diminish the volume of the viscus, showing that digitalis not only produces vasoconstriction, but produces vasoconstriction of such a degree as to overcome the simultaneous increase in cardiac output. In attempting to conform the findings of the laboratory worker with this statement of these clinicians, it should be borne in mind that the clinician has less accurate methods of investigation at his disposal—he usually abstains from connecting his patient's carotid artery with a mercurial manometer, nor does he enclose a loop of intestine in an oncometer; and so possibly he fails to observe some of the more typical effects of the drug. Again, man possesses a much more sensitive vasomotor-cardiac reflex control than does the laboratory animal, so that factors which tend to raise the blood-pressure are very readily obscured by reflex effects. Further it can be shown that increased cardiac output may be obtained by concentrations of digitalis too low to produce any effect on the vessels, so that it is possible that the clinician fails to produce the full physiological action of the drug. Other forms of **plain muscle** are stimulated, increased tonus and more forcible movements resulting. On the **kidneys** digitalis produces an indirect diuretic effect in those cases only in which there exists an impaired circulation; this diuretic action is brought about simply by increasing cardiac output and so ensuring an adequate circulation of blood through the kidneys. **Excretion** is slow, partly in the urine and partly in the fæces. Digitalis is excreted more slowly than it is absorbed, and so it may produce **cumulative** effects.

Whilst the effects described are common, more or less, to all the members of the group, certain minor differences are seen; as compared with digitalis, **strophanthus** is less irritant and less powerful as a vasoconstrictor, and so may act more efficiently as a diuretic. **Squill** has a more pronounced action on the musculature both of the heart and blood-vessels.

DIGITONIN. See under **Digitalis.**

DIGITOXIN. See under **Digitalis.**

DILL. See under **Volatile oils.**

DIONINE, syn. Ethyl morphine, *gr.* $\frac{1}{4}$–$\frac{1}{2}$ (0·016–0·03 *Gm.*). See under **Opium.**

DISINFECTANTS. See under **Antiseptics.**

DIURETICS, drugs which increase the flow of urine, may be classified as—

(a) **saline diuretics,** e. g. **nitrates,** which produce an increased flow of urine by salt action (see under **Osmosis**);

(b) **irritants,** any irritant finding its way to the kidney stimulates the renal epithelium to increased activity—e. g. **volatile oils ;**

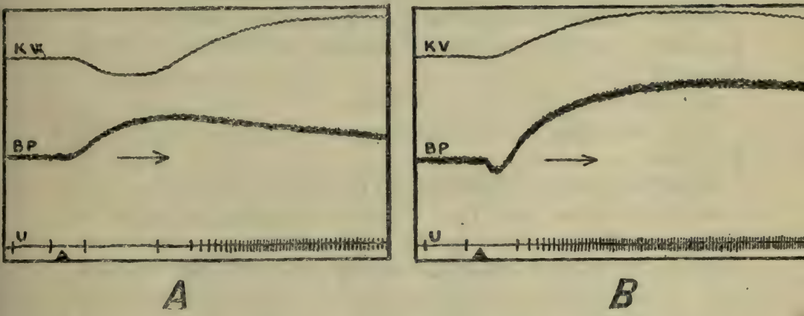


Fig. 7.—Cat, urethane, blood-pressure recorded by a mercury manometer in connection with a carotid artery; kidney-volume (varying with the amount of blood in the renal vessels) by enclosing the kidney in an oncometer, the writing-point in connection with which records an increase in volume by an upstroke; urine drop-record. Caffeine was injected into a vein at the mark in tracing A, and pituitrin in tracing B. It will be seen that after pituitrin the increase in kidney-volume is almost immediate and the increase in diuresis accompanies it; whereas after caffeine the renal vessels at first constrict, along with other splanchnic vessels (medullary stimulation), the flow of urine at the same time falling off—later the constriction of the renal vessels gives place to dilatation, though the other splanchnic vessels remain constricted and blood-pressure remains above the normal level; increased diuresis accompanies the onset of renal vasodilatation.

(c) **digitalis group,** which act as diuretics only indirectly and in pathological conditions (see under **Digitalis**);

(d) **hydragogue purgatives** frequently produce a secondary diuretic effect, probably by reabsorption of part of the fluid extravasated from the gut;

(e) **" specific " diuretics,** e. g. **caffeine** and **pituitrin,** which dilate the renal vessels whilst the blood-pressure and cardiac output remain normal, if not actually increased. After caffeine the renal vessels at first share in the general vasoconstriction (with an initial and temporary diminution in the flow of urine); pituitrin dilates the renal vessels from the start (*vide* Fig. 7). See also under **Caffeine** and **Pituitary.**

DIURETIN, syn. Theobromine sodium salicylate, *gr.* 10–20 (0·6–1·2 *Gm.*). See under **Theobromine.**

DUBOISINE, an alkaloid obtained from Duboisia myoporoides, has pharmacological actions similar to those of **Atropine** (q.v.).

ECGONINE. See under **Cocaine.**

ELATERIUM, syn. Squirting cucumber. See under **Purgatives.**

EMETICS (and **EXPECTORANTS**):—

Emesis or vomiting is a complicated reflex action controlled by the vomiting centre in the medulla: this centre may be stimulated either directly or reflexly. So emetics may be classified according to their seat of action, whether it is (a) central or (b) peripheral.

(a) **Centrally acting emetics** act much more rapidly if injected into the circulation than if given by the mouth, and they will not produce vomiting unless they can obtain access to the medulla. They will produce vomiting if painted on the exposed medulla. The only important member of this group is **apomorphine,** a synthetic product obtained by removal of a molecule of water from the morphine molecule. This drug directly stimulates the medulla; it seems to have a stronger affinity for the vomiting and respiratory centres than for other centres situated in the medulla, though these, too, may be stimulated by larger doses. It is a valuable emetic in cases of poisoning, acting with great rapidity and possessing the advantage that after its use the stomach contents are not interfered with if these are required for analysis from a medico-legal point of view. In smaller doses apomorphine acts as an expectorant.

(b) **Peripherally acting emetics** produce vomiting reflexly:

their direct action is on sensory nerve-endings in the gastric mucous membrane, which they stimulate, and so they initiate vomiting reflexes through the medulla. Peripherally acting emetics act more rapidly if given by mouth than if injected. They produce no vomiting if painted on the medulla. Any substance which irritates the gastric mucous membrane may act as an emetic, thus members of the digitalis group frequently cause nausea and vomiting. Emetics which act in this way are—

Ipecacuanha (q.v.).
Alum (q.v.).
Copper sulphate. See under Heavy metals.
Zinc sulphate. See under Heavy metals.
Ammonium carbonate (q.v.).
Tartar emetic (q.v.),

as well as the more homely gastric irritants, such as **mustard, salt and water,** or even warm water alone in bulk.

All emetics in doses too small to cause vomiting act as **expectorants** (q.v.).

EMETINE, *gr.* 1/100–1/25 (0·0006–0·0025 *Gm.*) as expectorant—*gr.* 1/12–1/6 (0·005–0·01 *Gm.*) as emetic, is an alkaloid obtained from **ipecacuanha** (q.v.). Emetine is also used in the treatment of amœbic dysentery in hypodermic injections of *gr.* ½ (0·03 *Gm.*).

EMODIN, syn. Trioxymethylanthraquinone, an active principle of **senna.** See under **Purgatives.**

EMPLASTRA. See under **Pharmacopœial preparations.**

EMULSIN, a ferment contained in almonds. See under **Prussic acid.**

EPINEPHRIN, syn. **adrenalin** (q.v.).

EPSOM SALTS, syn. **magnesium sulphate,** ℥ 2–4 (8–16 *Gm.*). See under **Purgatives.**

ERGAMINE, syn. Histamine, β-iminazolylethylamine. See under **Ergot** and **Amines.**

ERGOT, secale cornutum, the diseased heads of rye affected by a fungus, claviceps purpurea, contains an alkaloid, **ergotoxine** and several putrefactive amines, the more important of which are **tyramine** and **histamine** (see also under **Amines**). Ergotoxine is the amorphous hydrate of ergotinine, a crystalline alkaloid which is inactive. Ergotoxine is insoluble in water, so that watery preparations of ergot contain little or none of this principle; further it is an unstable body, so that even those preparations which contain ergotoxine when fresh soon lose all their content of this body. The physiological effects which are associated with ergot are mostly referable to the tyramine and histamine.

In the table some of the actions of the three main active principles of ergot are compared with the corresponding actions of adrenalin (typifying a drug which stimulates **all** sympathetic " nerve-endings ") and of barium (typifying a drug which stimulates all plain muscle). The differences between the actions of ergotoxine and of tyramine, on the one hand, and of adrenalin on the other hand, are referable only to their relative affinities for motor or inhibitor sympathetic (see also under **Uterus,** action of drugs on). In the case of ergotoxine its affinity for motor and its failure to affect inhibitor " nerve-endings " is well shown by " Dale's vasomotor paradox "; if an injection of adrenalin be given to an animal the blood-pressure rises owing to stimulation of all sympathetic myoneural junctions (adrenalin stimulates both motor and inhibitor with equal force, but the motor—or constrictor—predominate over the inhibitor—or dilator—in the arterioles). If now a large injection of ergotoxine is given and then a second injection of adrenalin, the effect of the latter is now to produce a fall in blood-pressure from vasodilatation; the adrenalin still acts in exactly the same way as before, but now it finds only inhibitor—or dilator—" nerve-endings " available, all the motor—or constrictor—nerve-endings having been paralysed by the ergotoxine. The actions of ergotoxine and tyramine are not eliminated or changed in any way by previous atropinisation: this shows

	Ergotoxine.	Tyramine.	Histamine.	Adrenalin.	Barium.
General	+ — motor sympathetic nerve-endings (no effect on inhibitor)	+ sympathetic nerve-endings (greater affinity for motor than inhibitor)	usually said to stimulate plain muscle directly	+ sympathetic nerve-endings (inhibitor = motor)	stimulates plain muscle directly
Blood-vessels	constrict (Dale's vasomotor paradox)	constrict	dilate (with certain exceptions)	constrict (with certain exceptions)	constrict
Heart	augmented quickened	quickened augmented	augmented slowed	quickened augmented	augmented slowed
Blood-pressure	+	+	−	+	+
Uterus	contracted	usually contracted	contracted (rat's uterus inhibited)	varies	contracted
Vas deferens	contracted	contracted	no action	contracted	contracted

that these drugs do not produce their effects by an action on the cranio-sacral autonomic system. As regards histamine there are difficulties in the way of explaining its action; its effects are dissimilar to those produced by sympathetic stimulation; in some respects they resemble those produced by stimulation of the cranio-sacral autonomic, but its action is not interfered with by atropine; it is usually said to act by direct stimulation of plain muscle, and in many instances (heart, bronchioles, intestine) the actions of barium and of histamine are identical in kind, but certain plain muscle organs (e. g. the uterus of the rat and the vas deferens of most animals) react to histamine quite differently from the way in which they react to barium. It seems best to assume that the action of histamine is on some peripheral receptor present in most plain muscle, but absent from certain forms.

However interesting the actions of ergotoxine, tyramine and histamine may be, they are not, as a rule, prescribed separately in medicine. Preparations of ergot containing variable proportions of the three are used. The effects on different organs are the resultants of the effects of the different constituents of the ergot. See also under **Standardisation.**

ERGOTIN, syn. Extractum ergotæ, *gr.* 2–8 (0·12–0·5 *Gm.*).

ERGOTININE, a crystalline alkaloid isolated from ergot by Tanret in 1875 and found to be physiologically inert. The

ERGOTOXINE of Dale and Barger is ergotinine hydrate and possesses powerful physiological actions. See under **Ergot.**

ERNUTIN, a proprietary preparation containing ergotoxine, tyramine and histamine in solution.

ERYTHROL TETRANITRATE, *gr.* ½–1 (0·03–0·06 *Gm.*). See under **Nitrites.**

ERYTHROPHLŒINE, a glucosidal alkaloid obtained from erythrophlœum (Sassy bark), with a digitalis-like action.

ESERINE, syn. Physostigmine, *gr.* 1/60–1/20 (0·001–0·003 *Gm.*), an alkaloid obtained from calabar bean. See under **Physostigmine.**

ESSENTIAL OILS. See under **Volatile oils.**

ETHER $(C_2H_5)_2O$, ♏ 15–30 (1–2 c.c.), resembles **chloroform** (q.v.) in its actions, and is used for the same purposes. Chloroform is roughly three times as active as ether on the CNS, whilst the toxicity of the former to the cardiac muscle is more than twenty times that of the latter. Ether is thus much safer as a routine anæsthetic. Ether evaporates more rapidly than chloroform, and so has a greater cooling effect on any part to which it is applied. The main disadvantages of ether as a general anæsthetic are that induction of anæsthesia is slower than by chloroform, and that it is more irritant to the respiratory passages. See also under **Chloroform** and **Anæsthetics (general).**

ETHYL CHLORIDE, C_2H_5Cl, evaporates very quickly and so may be used to freeze and render anæsthetic any tissue on which it is sprayed. If given by inhalation it produces general anæsthesia very rapidly and may be used for a short time for this purpose, followed as soon as anæsthesia is produced by ether. It is less depressant to the heart than chloroform, but several fatalities have occurred, and it is not so freely used now as at one time.

ETHYLHYDROCUPREINE, syn. Optochin, *gr.* 8 (0·5 *Gm.*), was introduced as a specific antipneumococcal remedy. It kills pneumococci in vitro and in some of the lower animals, but in man it does not come up to expectations: moreover, untoward effects, such as optic neuritis and blindness, have followed its use. See also under **Cupreine** and **Quinine.**

ETHYL MORPHINE, syn. Dionine. See under **Opium.**

ETHYL SULPHONAL (diethyl sulphonal), syn. Tetronal, *gr.* 10–20 (0·6–1·2 *Gm.*). See under **Hypnotics.**

EUCAINE, syn. Benzamine lactate, *gr.* $\frac{1}{8}$–$\frac{1}{2}$ (0·008–0·03 *Gm.*). See under **Cocaine.**

EUCALYPTUS. See under **Volatile oils.**

EUMYDRINE, syn. Methyl atropine. See under **Atropine.**

EUONYMUS, the bark of Euonymus atropurpureus (Wahoo bark), contains glucosides of the digitalis series; its irritant action on the intestinal mucous membrane precludes its use as a cardiac tonic; it is used in medicine solely as a **purgative** (q.v.).

EXALGIN, syn. Methylacetanilide, *gr.* ½–2 (0·03–0·12 *Gm.*). See under **Antipyretics.**

EXODIN, a synthetic anthraquinone derivative, *gr.* 8–15 (0·5–1·0 *Gm.*). See under **Purgatives (anthracene).**

EXPECTORANTS, drugs which increase the flow of bronchial mucus. Any **emetic** (q.v.) in small dose produces a reflex expectorant action. In addition to the drugs also used as emetics the following are used as expectorants: **senega,** containing saponin bodies which irritate the gastric mucous membrane and so initiate the expectorant reflex; **iodides** (q.v.), which are excreted partly into the stomach and partly in the respiratory mucus (as well as by other routes); this excretion is probably accompanied by setting loose of free iodine and of hydriodic acid, which directly stimulate the respiratory and gastric mucous membranes.

EXTRACTA. See under **Pharmacopœial preparations.**

FEL BOVINUM, ox bile, *gr.* 5–15 (0·3–1·0 *Gm.*). See under **Cholagogues.**

FERRATIN, a complex organic combination of **iron** (q.v.), *gr.* 8–15 (0·5–1·0 *Gm.*).

FIGS. See under **Purgatives.**

FILIX MAS, male fern. See under **Anthelmintics.**

FLUORIDES resemble the **oxalates** (q.v.) in their power of combining with and precipitating the tissue calcium.

FORMALDEHYDE ($HCOH$). See under **Antiseptics.**

FORMALIN, a watery solution of formaldehyde.

FOXGLOVE (digitalis purpurea). See under **Digitalis.**

GALBANUM, a gum-resin. See under **Volatile oils.**

GALLIC ACID,

$C_6H_2 \cdot (OH)_3 \cdot COOH \cdot COOH \cdot (OH)_3 \cdot C_6H_2$, possesses no astringent action, but is closely allied to **tannic acid,** an anhydride of gallic acid, which is **astringent** (q.v.).

GALLS, syn. Oak galls, contain tannic and gallic acids. See under **Astringents.**

GAMBIR, an extract of the wood of Ourouparia gambir, *gr.* 5–15 (0·3–1·0 *Gm.*). See under **Astringents.**

GAMBOGE, *gr.* $\frac{1}{2}$–2 (0·03–0·12 *Gm.*). See under **Purgatives.**

GANGLION-CELLS, drugs acting on. A group of drugs of which **nicotine, coniine** and **lobeline** are the more important, owe their pharmacological action largely to their power of depressing and paralysing (after an initial stimulation) all peripheral ganglion-cells belonging to the sympathetic and cranio-sacral autonomic systems. See also under **Seats of action of drugs.**

GELATIN, an albuminoid obtained from bones and other animal tissues. See under **Pharmacopœial preparations.**

GELSEMINE }
GELSEMININE } alkaloids obtained from Gelsemium nitidum (yellow jasmine), belong to the **nicotine-coniine** group of drugs.

GENTIAN, the root of Gentiana lutea, contains bitter principles. See under **Bitters.**

GIN, an alcoholic spirit containing the volatile oil of Juniper. See under **Volatile oils.**

GINGER. See under **Volatile oils.**

GITALIN, syn. Digitalein. See under **Digitalis.**

GLANDS, SECRETING, action of drugs on. Drugs of widely different classes produce effects on different glands of secretion; thus any member of the class of expectorants reflexly affects the mucous glands of the bronchi. Again the secretion of a gland may be altered by a drug which acts on any part of the innervation of the gland, pilocarpine, atropine and adrenalin are examples of this class. The simple bitters produce reflex increase in the activity of the gastric mucous glands, whilst the volatile oils as a class and other mildly irritant drugs produce a certain stimulation of all gland cells which they reach. (See Fig. 8.)

GLAUBER'S SALTS, syn. Sodium sulphate, *gr.* 30–120 (2–8 *Gm.*), or up to *gr.* 240 (16 *Gm.*) as a single dose. See under **Purgatives.**

GLUCOSIDES, hydroxyl compounds of sugars, which split up on heating with an acid or under ferment action.

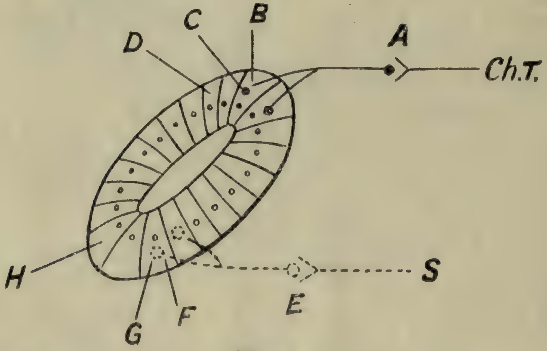


FIG. 8.

A = Ganglion-cell on chorda tympani branch of VII.
B = Nerve-ending of chorda tympani in submaxillary gland.
C = Myoneural[1] junction of chorda tympani in submaxillary gland.
D = Gland-cell supplied by chorda tympani.
E = Ganglion-cell on sympathetic.
F = Nerve-ending of sympathetic in submaxillary gland.
G = Myoneural[1] junction of sympathetic in submaxillary gland.
H = Gland-cell supplied by sympathetic.

Drugs acting on A and E.—Nicotine + −, etc.
Drugs acting on B and C.—Pilocarpine +, atropine −, etc.
Drugs acting on D and H.—Volatile oils +, iodine +, K −, etc.
Drugs acting on F and G.—Adrenalin +, ergotoxine + −, etc.

Many powerful pharmacological agents belong to this group, e. g. the active principles of digitalis.

GLUSIDUM, syn. Saccharin, $C_6H_4 \cdot CO \cdot SO_2 \cdot NH$, *gr.* ½–2 (0·03–0·12 *Gm.*), a toluol derivative with an intensely sweet taste. It is very insoluble (1–400) in water; the sodium compound ("soluble saccharin") is easily soluble.

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[1] The term "*Myo*neural" is inadmissible in connection with a gland-cell, but has been retained to make Fig. 8 conform with other figures.

GLYCERIN, $C_3H_5(OH)_3$, obtained by the decomposition of fixed oils, is somewhat irritant to the tissues on account of its affinity for water. It is used mainly as a solvent for drugs and as a hydragogue rectal enema. See under **Pharmacopœial preparations.**

GLYCEROPHOSPHATES have been used in medicine with the idea that their phosphorus would be of use in the formation of **lecithin.** The evidence points to their action being similar to that of the inorganic phosphates, and to the conclusion that their phosphorus content is not utilisable in this way.

GLYCYRRHIZA, Liquorice, *gr.* 5–20 (0·3–1·2 *Gm.*). See under **Demulcents.**

GOLD has the general action of the **Heavy metals** (q.v.). In the form of a double chloride (with sodium), of a double cyanide (with potassium), and in colloidal solution it has been used in the treatment of syphilis and other general infections.

GOLDEN SEAL, syn. Hydrastis. See under **Hydrastine.**

GUAIACOL, $C_6H_4 \cdot OCH_3 \cdot OH$, ♏ 1–5 (0·06–0·3 c.c.). See under **Antiseptics.**

GUAIACUM, *gr.* 5–15 (0·3–1·0 *Gm.*), the resin obtained from Guaiacum officinale. See under **Volatile oils.**

GUIPSINE, a liquid alkaloid obtained from mistletoe, is said to lower blood-pressure without depressing the heart, and has been used in the treatment of arterio-sclerotic conditions.

HABITS. Drug habits are formed either as a result of a too prolonged administration of a drug, so that the patient comes to rely on it and to be unable to do without it; or sometimes as a result of curiosity on the part of an individual, who tries the effect of a drug on himself independently of medical treatment. The pernicious rôle played by certain proprietary preparations—one might single out "tonic wines" containing cocaine—in initiating a habit should not be lost sight of. The drugs most commonly involved in the formation of habits are **opium**

and its derivatives, **alcohol,** the **hypnotics** generally, **cocaine, Indian hemp** and perhaps one should add **caffeine** and **tobacco.** The ill-effects of drug habits may be referable either to the action of the drug itself or to the impaired will-power of the subject; in most cases the two factors are interdependent. Without doubt a powerful influence in the formation of most habits is the pleasant, high-spirited sensation produced as the immediate effect of the drug. It is significant that the more important of these drugs (opium, alcohol, cocaine, cannabis and the hypnotics—all of which depress the higher centres before the lower) may at one time or another produce the same state of affairs in the cerebral economy—a relative elimination of the higher controlling centres of the brain with a relative hyperactivity of the more automatic centres of the motor areas and mid-brain. In this condition the state of the subject is such that all moral sense is eliminated and he behaves as an animal. As time goes on the victim of the habit usually finds himself in the police-court as a result of some escapade directly referable to this loss of moral control.

HÆMATOXYLON, syn. Logwood. See under **Astringents.**

HAMAMELIS, witch hazel. See under **Astringents.**

HASHISH, syn. Indian hemp, cannabis indica (q.v.).

HEART, action of drugs on. Drugs may affect the heart's action in a variety of ways. The beat of the heart may be quickened or slowed; its amplitude may be increased or diminished.

(a) The heart is **quickened**—

1. By drugs which stimulate any part of its sympathetic innervation (**nicotine, adrenalin**). Some increase in amplitude is also produced.

2. By drugs which stimulate the excito-motor area (**caffeine**).

(b) The heart is **slowed**—

1. By drugs which stimulate any part of the vagal innervation (**digitalis, strychnine, pilocarpine**).

2. By drugs which stimulate the cardiac muscle (**barium,**

digitalis). Stimulation of cardiac muscle produces increase in amplitude as well as slowing.

(c) The amplitude of the heart-beat is **increased**—

1. By drugs which stimulate cardiac muscle (**calcium, barium, digitalis**). Slowing is usually produced at the same time.

2. By drugs which stimulate any part of the sympathetic innervation (**adrenalin**). Cardio-acceleration is also produced.

(d) The amplitude of the beat is **diminished** by drugs which depress cardiac muscle (**chloroform, potassium**).

The effect of a drug on the heart may be determined either on the isolated heart (e. g. of a rabbit) perfused through the coronary vessels, and suspended in such a way that contraction of the ventricle pulls on a lever which records the movements. The drug is then introduced into the perfusion fluid before it reaches the heart. Or the movements of an intact heart may be recorded either by attaching a lever to the apex or by enclosing the whole heart in an air-tight oncometer (cardiometer); in the latter case the record simply shows changes in the volume of the heart; the volume diminishing with each contraction, as blood is forced from the heart, increasing with each diastole, as the heart fills with blood. A cardiometer tracing, then, will show the effect of a drug which depresses heart muscle, and which consequently causes the chambers of the heart to become engorged with blood, by an increase in the volume of the heart during diastole and by a smaller diminution in the volume during systole. On the other hand, a drug which stimulates the heart muscle to a more efficient contraction will produce a cardiometer tracing showing a smaller volume at the height of systole; in other words the chambers of the heart are made to empty themselves more completely, so that they contain less residual blood, at each contraction. A cardiometer tracing of digitalis usually shows an increase in the extent of the movements in both directions; the heart muscle is stimulated to more efficient contraction, so that there is more complete emptying of the chambers (= smaller volume) in systole; whilst at the same time owing to the slowing of the rate the diastolic pause is prolonged, so that at each diastole there is more time for the chambers to fill with blood and the volume in consequence increases.

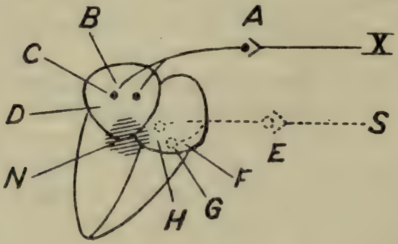


FIG. 9.

A = Ganglion-cell (intracardiac) on vagus (X).
B = Nerve-ending of vagus.
C = Myoneural junction of vagus.
D = Cardiac muscle supplied by vagus.
E = Ganglion-cell on sympathetic (S).
F = Nerve-ending of sympathetic.
G = Myoneural junction of sympathetic.
H = Cardiac muscle supplied by sympathetic.
N = Excito-motor area of heart.

Drugs acting on A and E.—Nicotine + –, etc.

Drugs acting on B and C.—Pilocarpine +, arecoline +, muscarine +, atropine –, digitalis +, etc.

Drugs acting on D and H.—Barium +, digitalis +, calcium +, chloroform –, K –, nitrites –, etc.

Drugs acting on F and G.—Adrenalin +, tyramine +, ergotoxine + –, etc.

Drugs acting on N.—Caffeine +.

It should be obvious that the distance of the excursion of the lever with each beat of the heart registers the output of blood from the heart (= difference in volume of the full heart and of the empty heart).

HEAVY METALS. This pharmacological group includes as its chief members mercury, lead, iron, bismuth, copper, zinc. All the heavy metals possess in common—

(a) A local action—astringent and irritant.

(b) A general action—general protoplasmic poisons.

The local **astringent** action of a salt of one of the heavy metals is produced in one or more of three ways—

1. Soluble salts combine with albumen to form albuminates.
2. After local absorption soluble salts act directly on the walls of blood-vessels producing local vasoconstriction, which helps to dry up the part.
3. Insoluble salts are deposited and form a layer or covering over the part to which they are applied, and so render it dry and protect it.

The **general protoplasmic poisonous** action is seen in greater or smaller degree with all the heavy metals; the toxicity depends, as a rule, rather on the rate of absorption than on any specific toxicity of the metal. Mercury is much more rapidly absorbed than any other member of the group, and in consequence its apparent toxicity is far greater than that of any other heavy metal. An idea of the toxicity of these metals, if they reach the tissues, is obtained by considering the fact that the minute trace of copper contained in distilled water prepared from a copper-lined still is quite sufficient to stop the activity of organs placed in Ringer's solution made from such water. Ringer's solution for such purposes must be made up with water distilled from a glass still.

After absorption certain symptoms of poisoning are produced more or less in common by all the members of the group; these are referable mainly to (a) the **nervous system** —delusions, delirium, stupor, tremors, spasms or convulsions with peripheral neuritis and paralysis; and (b) the **gastro-intestinal tract**—pain, nausea, vomiting and diarrhœa. The plain muscle of the intestine is thrown into tonic contraction by the direct action of the heavy metals, producing colicky pains, frequently accompanied by obstinate constipation. Other forms of plain muscle are similarly affected. Excretion of the heavy metals is slow;

symptoms of poisoning are often produced as a result of cumulative action, e. g. in chronic lead poisoning. Excretion takes place (a) by the large intestine; (b) by the kidneys. Inflammation, particularly of the kidneys, is frequently set up during excretion.

HEDONAL (methyl propyl carbinol urethane), *gr.* 15–30 (1–2 *Gm.*). See under **Hypnotics.**

HEMISINE, syn. Adrenalin (q.v.).

HEMLOCK (Conium maculatum), contains an alkaloid, **coniine** (q.v.).

HENBANE (Hyoscyamus niger), contains alkaloids, **atropine, hyoscyamine, hysocine** (q.v.).

HEROINE, syn. Diacetylmorphine, diamorphine, *gr.* 1/25–$\frac{1}{8}$ (0·0025–0·008 *Gm.*). See under **Opium.**

HEXAMETHYLENETETRAMINE
HEXAMINE
} syn. Urotropin, *gr.* 5–15 (0·3 – 1·0 *Gm.*). See under **Antiseptics.**

HISTAMINE, syn. β-iminazolylethylamine, ergamine, one of the active principles of **Ergot** (q.v.). See also under **Amines.**

HOLOCAINE. See under **Cocaine.**

HOMATROPINE, *gr.* 1/80–1/20 (0·0008–0·003 *Gm.*), an artificial tropeine formed by combining tropine with mandelic acid. See under **Atropine.**

HYDRAGOGUE PURGATIVES. See under **Purgatives.**

HYDRASTINE, *gr.* $\frac{1}{2}$–1 (0·03–0·06 *Gm.*), an alkaloid found in Hydrastis canadensis (Golden seal), which contains also berberine and canadine. Hydrastine is very similar in structure to narcotine (see under Opium); it is readily decomposed to form hydrastinine in the same way in which narcotine decomposes to form cotarnine. Hydrastine depresses the **CNS** after an initial stimulation; it also has a stimulant action on **plain muscle,** particularly that of the uterus, though its action here is less noteworthy than that of ergot. It is excreted unchanged in the urine.

HYDRASTININE. See under **Hydrastine.**

HYDRASTIS. See under **Hydrastine.**

HYDROCYANIC ACID, syn. Prussic acid (q.v.).

HYDROQUININE. See under **Quinine.**

HYDROQUINONE. See under **Antiseptics.**

HYDROXYPHENYLETHYLAMINE, syn. Tyramine. See under **Ergot.**

HYOSCINE, syn. Scopolamine, *gr.* 1/200–1/100 (0·0003–0·0006 *Gm.*), an alkaloid obtained from hyoscyamus and datura stramonium. See under **Atropine.**

HYOSCYAMINE, *gr.* 1/200–1/100 (0·0003–0·0006 *Gm.*), an alkaloid obtained from belladonna, hyoscyamus and datura stramonium. See under **Atropine.**

HYOSCYAMUS, syn. Henbane, contains alkaloids atropine (q.v.), hyoscyamine and hyoscine.

HYPERTONIC SOLUTIONS. See under **Osmosis.**

HYPNOTICS—drugs producing a condition resembling sleep—are mostly derivatives of **methane.** They are less volatile than the general anæsthetics, and in consequence their action is less sudden and more prolonged. The hypnotics may be classified in three groups—

1. The **Chloral** group.

Chloral Hydrate, $CCl_3CH(OH)_2$, *gr.* 5–20 (0·3–1·2 *Gm.*).

Butyl Chloral Hydrate, $CH_3 \cdot CHCl \cdot CCl_2 \cdot CH(OH)_2$, *gr.* 5–20 (0·3–1·2 *Gm.*).

Chloralamide, syn. Chloral formamide, $CCl_3CH(OH)NH \cdot COH$, *gr.* 15–45 (1·0–3·0 *Gm.*).

Chloralose, $C_8H_{11}Cl_3O_6$, *gr.* 3–10 (0·2–0·6 *Gm.*).

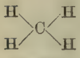
Bromal Hydrate, $CBr_3CH(OH)_2$, *gr.* 2–5 (0·12–0·3 *Gm.*).

Paraldehyde $(CH_3 \cdot COH)_3$, ℳ 30–120 (2–8 c.c.).

The hypnotic action of chloral was at one time thought to be due to the fact that it was converted into chloroform in the tissues. There is no evidence in favour of this view; no chloroform can be detected in the tissues, and chloral can be recovered unchanged in the urine.

Chloral depresses the whole of the **CNS,** acting from above downwards. It produces a condition resembling natural sleep—slow respiration, reflexes not abolished, no analgesic effect. Depression of the medullary activities produces some **vasodilatation** (erythematous rashes sometimes follow a dose of chloral); it also exerts a directly depressant action on the **heart-muscle. Blood-pressure** is lowered from both these effects. The depressant action on the heart is sufficient to contraindicate the drug in cases with a weak action of the heart. **Body-temperature** is lowered (a) from diminished heat production; (b) from increased heat loss. **Striped muscle** is not affected by therapeutic doses; in higher concentrations the muscle goes into rigor. **Excretion** takes place in the urine, some unchanged and some combined with glycuronic acid.

2. The **Sulphonal** group.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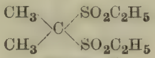
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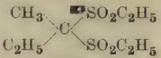
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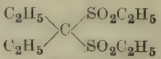

Tetronal

Sulphonal, *gr.* 10–30 (0·6–2·0 *Gm.*), has little or no depressant action on the **heart,** it is **absorbed** very slowly and should be administered some three hours before its action is desired. **Excretion** is even slower than absorption, so that **cumulative** effects may occur—sometimes a hypnotic action is produced on two nights after a single dose. Toxic symptoms due to idiosyncrasy, an overdose, or to cumulation consist in hallucinations, inability to cerebrate, gastritis and blood changes, more particularly the formation of **hæmatoporphyrin,** with the production of dark-coloured urine.

Trional, syn. Methyl ethyl sulphonal, *gr.* 10–30 (0·6–2·0 *Gm.*), is more soluble and more rapidly absorbed than sulphonal.

Tetronal, syn. Diethyl sulphonal, *gr.* 10–20 (0·6–1·2 *Gm.*), occupies a position intermediate between sulphonal and trional both as to solubility and rapidity of absorption. It is now but little used.

3. The **Urethane** group.

Derivatives of **urea** which produce a quiet sleep without depressant action on the heart.

Ethyl urethane, syn. Ethyl carbamate, *gr.* 10–60 (0·6–4·0 *Gm.*), largely used in dose of 1·0–1·5 *Gm.* per kilo as a general anæsthetic for laboratory animals.

Luminal, syn. Phenyl ethyl malonyl urea, *gr.* 2–10 (0·12–0·6 *Gm.*).

Hedonal, syn. Methyl propyl carbinol urethane, *gr.* 15–30 (1·0–2·0 *Gm.*).

Veronal, syn. Barbitone, *gr.* 5–10 (0·3–0·6 *Gm.*).

HYPOPHOSPHITES were at one time erroneously supposed to exert some beneficial action on nutrition. They are easily absorbed and are excreted unchanged in the urine.

HYPOPHYSIN, syn. Pituitrin (q.v.).

HYPOTONIC SOLUTIONS. See under **Osmosis.**

ICHTHYOL. See under **Antiseptics.**

IDIOSYNCRASY. A few individuals possess an idiosyncrasy for certain drugs; that is to say, that a small dose of one of these drugs is liable in these people to produce abnormal, untoward or toxic effects. The chief drugs to which people show idiosyncrasies are **coal-tar** derivatives, **quinine, bromides** and **iodides, mercury, opium** and **belladonna.**

IMMUNITY. The terms "immunity" and "tolerance" should not be loosely interchangeable. A true immunity against enteric fever or small-pox may be conferred by adequate treatment with a vaccine, but animals do not as a rule become immune to drugs in the same degree; a certain amount of tolerance may be found, either natural or acquired, but this does not constitute true immunity. See also under **Tolerance.**

INDIAN HEMP, syn. Cannabis Indica (q.v.).

INFUNDIBULIN, syn. Pituitrin (q.v.).

INFUSA. See under **Pharmacopœial preparations.**

INJECTIONES. See under **Pharmacopœial preparations.**

INTESTINE, drugs acting on. The intestine may be considered as a muscular tube with circular and longitudinal muscle fibres, the former being in certain areas specialised as sphincters, with a lining of specialised mucous membrane and a complex innervation. The vagus sends motor nerves and the sympathetic inhibitor, whilst within the wall of the intestine lies Auerbach's plexus. The class of **purgative** drugs is considered elsewhere. **Astringents** and **irritants** (q.v.) produce actions on the intestinal mucous membrane essentially similar to those they produce elsewhere. For the rest consideration of the accompanying diagram may help. Any drug stimulating any part of the vagus innervation produces an augmentation of the intestinal movements, whilst sympathetic stimulants inhibit these movements. Stimulants of the plain muscle produce a notable increase in tonus with or without increase in movements. One should note that the receptor on the peripheral vagus of the intestine, on which pilocarpine and atropine act, is situated somewhat differently from the corresponding receptor in the case of the submaxillary gland or pupil. In these cases it will be remembered that, after atropine, stimulation of the chorda tympani or of the third cranial nerve, produces no salivary secretion and no pupil-constriction; but if the vagus to the intestine be stimulated after complete atropinisation increased intestinal movements still result. Nevertheless atropine completely antagonises pilocarpine on the gut as on the salivary gland and pupil. It is considered, therefore, that in the case of the gut this pilocarpine-atropine vagal receptor lies just off the direct path of nervous impulses from the vagal centre, though still in intimate connection with the nerve-muscle junction of the vagus. Thus atropine, whilst effectually eliminating such irregular contractions of the gut as are produced by pilocarpine, does not prevent all intestinal movements. The sympathetic, though mainly inhibitor to the intestine in function, supplies motor fibres to the pyloric, ileocœcal and internal anal sphincters, as it does, too, to the muscularis mucosæ; so that adrenalin causes these muscles to contract whilst it inhibits the main intestinal musculature. The diagram, whilst not pretending to represent the exact anatomical relationships of Auerbach's plexus,

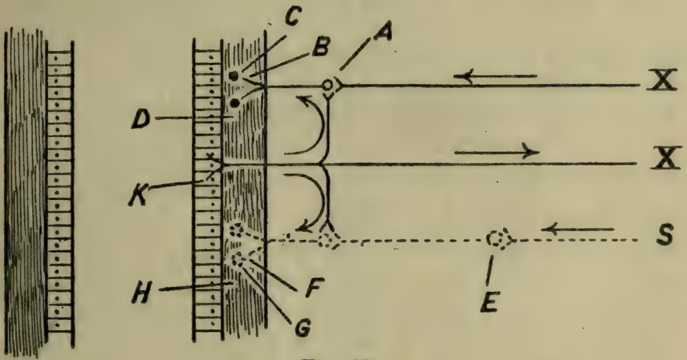


FIG. 10.

A = Ganglion-cell on efferent vagus (X), (motor nerve).
B = Nerve-ending on efferent vagus.
C = Myoneural junction on efferent vagus
D = Plain muscle of intestine supplied by vagus.
E = Ganglion-cell on sympathetic (S), (inhibitor nerve).
F = Nerve-ending of sympathetic.
G = Myoneural junction of sympathetic.
H = Plain muscle of intestine supplied by sympathetic.
K = Sensory nerve-endings of afferent vagus in mucous coat of intestine.

Impulses originating in K may spread out in Auerbach's plexus, causing stimulation of B and F, as well as proceeding up the afferent vagus. The result of this would be contraction of the musculature at D and relaxation at H.

Drugs acting on A and E.—Nicotine + −, etc. (opium alkaloids in high concentration depress E).

Drugs acting on B and C.—Pilocarpine +, physostigmine +, atropine −, etc.

Drugs acting on D and H.—Barium +, heavy metals +, digitalis +, pituitrin +, physostigmine +, nitrites −, chloroform −, etc.

Drugs acting on F and G.—Adrenalin +, ergotoxine + −, etc.

Drugs acting on K.—Irritants (e. g. purgatives) +.

Morphine during its excretion into the bowel depresses some part of Auerbach's plexus, and so produces constipation.

may serve to indicate the manner in which normal peristalsis may be maintained, and the ways in which such peristalsis may be modified by means of a drug acting on any part of the nervous path involved.

IODIDES. Apart from a small and insignificant degree of salt action, the action of the iodides is essentially similar to that of iodine, though less intense. Taken by the mouth **absorption** is rapid from the gastro-intestinal tract; the bulk of the dose taken is **excreted** as iodide in the urine, saliva, sweat, milk, and in the secretion of most mucous glands. It is probable that during excretion a small amount of free iodine, or of hydriodic acid, according to the seat of excretion, is liberated; and this by its irritant property is liable to produce inflammation of the parts involved—catarrh and inflammation of the nasal and pharyngeal mucous membranes, a metallic taste in the mouth, conjunctivitis, lachrymation, bronchitis and acneiform eruptions on the skin—all the symptoms of **iodism.** Free iodine being soluble in an excess of iodide, an attack of iodism may be cut short by increasing the dose of iodide, though the onset of the attack was due to the iodide ingested.

In **syphilis,** particularly in the later stages, the iodides have what is termed a "specific" action, though there is, of course, no true specificity as in the case of diphtheria antitoxin in diphtheria. The probable method of action here is that iodine is set free and combines with the cells of the gummatous growths, thereby accelerating their breaking down, and at the same time it may in a similar way enable the mercury or arsenic, one or other of which is usually administered at the same time, to reach the spirochæte more easily.

In **aneurysm** and **atheromatous conditions** generally the iodides are of use. At one time it was thought that the benefit which accrued was due to the fact that iodides lower the blood-pressure, but they have no such effect. It may be owing to an antisyphilitic action (many cases of these diseases have a history of syphilis), or perhaps on account of the action of the drug on the **thyroid gland,** where the iodothyrin is considerably increased in amount after iodides, and the activity of the gland is enhanced in proportion. For this reason iodides are given in certain cases of **hypothyroidism.**

Iodides are of use in the treatment of **chronic lead poisoning;** they combine with the albuminate of lead to form a double salt and hasten the elimination of lead from the tissues.

The **expectorant** action of iodides is often made use of, particularly when the respiratory mucus is thick and solid: here the action is referable to the irritation induced during excretion by the bronchial mucus, and a more liquid and less tenacious secretion results. Iodides are widely used in the treatment of **asthma,** particularly in the periods between attacks. The action here is probably this same expectorant effect; at all events the iodides have no broncho-dilator effect.

The iodides of sodium and of potassium are official in doses of *gr.* 5–20 (0·3–1·2 *Gm.*). Various organic combinations of iodine have been introduced in recent years, in the hope that the iodine would be gradually liberated from combination in the tissues, and that so a more gradual and more lasting effect would be produced than that of the inorganic iodides. Such combinations are iodipin and sajodin.

IODINE possesses all the effects of the iodides in an exaggerated degree; in addition it has an irritant and vesicant action when applied to the skin, and it possesses valuable antiseptic properties (see under **Antiseptics**).

IODOFORM, CHI_3, *gr.* $\frac{1}{2}$–3 (0·03–0·2 *Gm.*), is used as a dusting powder for septic surfaces. Of itself iodoform is an inert body, and its deodorant and antiseptic action is due to the fact that in the presence of putrefactive material free iodine is liberated.

IODOTHYRIN, syn. Thyroiodin, a complex organic form of iodine found in the colloid material of the thyroid gland. Whether this is or is not the actual active principle of the gland, it has been shown that the degree of activity of the gland and the amount of iodine in combination follow parallel curves. See also under **Thyroid.**

IONS. Many substances, particularly inorganic salts, when in solution split up into their constituent ions; and the pharmacological action of such a salt is largely the action of such ions rather than the action of the salt. In the case of a salt such as morphine acetate the action of the acetate ion is inconsiderable, since the morphine ion is so extremely potent and quite overshadows the acetate action. On the other hand, if potassium acetate be given the action of the negative ion (acetate) is of paramount importance. Ionisation is of importance to pharmacology in a variety of ways; thus certain substances do not ionise, and it is found that in such cases no toxic effects are produced even if certain components of such a substance are very poisonous (see under Arsenic). Again it was realised that the bromide ion is depressant to the CNS; it was thought then that by substitution of the Cl of chloral hydrate by Br a more sedative drug would be produced. The resultant bromal hydrate, however, was found to be no more sedative than the chloral hydrate simply because no dissociation takes place.

In another connection ionisation is of importance; it is found that the osmotic power of a solution depends not on the number of molecules of a salt in solution, but on the number of ions into which that salt dissociates, each ion exerting the same degree of osmotic pressure as the original molecule. Thus a salt which ionises is a far more powerful osmotic force than a body like sugar which does not ionise. The great importance of this to the body lies in the fact that osmosis is a physical force which performs its work without the expenditure of the animal's energy; so that the further a process, e. g. diuresis, can be carried on by osmosis, the less oxygen consumption is required. See also under **Osmosis.**

IPECACUANHA, the root of Cephælis ipecacuanha, contains three alkaloids, **Emetine, Cephæline** and **Psychotrine,** all of which are **Quinoline** derivatives. Apart from its action as an **expectorant** and as an **emetic** (q.v.), ipecacuanha has been used in the treatment of **amœbic dysentery.** Lately the active principle, emetine, has been used alone in this disease, and it appears to be almost a specific.

IRON possesses all the actions of the **heavy metals** (q.v.), and in addition some special actions of its own. Iron is a natural constituent of the tissues, particularly of hæmoglobin, and in those cases of anæmia (**chlorosis**) in which the corpuscles are deficient in hæmoglobin, benefit accrues from giving iron by the mouth. The exact reason why in chlorosis the natural organic iron of the food is insufficient or is not assimilable is not known. Various theories, such as that of **Bunge,** have been advanced, but have been shown to be wanting.

Ferrous salts combine with albumen to form albuminates which are soluble, non-irritating and non-corrosive. Ferric salts form precipitates of insoluble, irritant and astringent albuminates.

Iron is **absorbed** slowly from the first few inches only of the small intestine, probably in the form of an albuminate or carbonate. It is then taken up by leucocytes and carried to the liver, spleen and bone-marrow, where it enters into organic combination and is stored up. **Excretion** is still slower than absorption, and takes place mainly by the large intestine. From its astringent action it is liable to produce constipation and indigestion.

IRRITANTS. A large number of drugs belonging to many pharmacological classes (e. g. volatile oils, purgatives, emetics, heavy metals, etc.), act as irritants. The drugs which are used as irritants and for no other purpose are **cantharides** and **mustard.** These, together with iodine, are used for application to the skin, and several degrees of local irritant action may be produced : (1) **rubefacient ;** (2) **irritant;** (3) **vesicant;** (4) **pustulant.** Many other bodies, such as ricin and saponins, are irritant, but are not made use of.

ISOAMYLAMINE, an amine derived from leucin, is found in small quantities in some preparations of ergot. See also under **Amines.**

ISOTONIC SOLUTIONS. See under **Osmosis.**

JABORANDI. The leaves of Pilocarpus jaborandi contain pilocarpine and other alkaloids. See under **Pilocarpine.**

JALAP, the root of Ipomœa purga. See under **Purgatives.**

JEQUIRITY BEAN, the seed of Abrus precatorius, contains a vegetable toxin, **abrin.** See under **Toxins.**

JUNIPER. See under **Volatile oils.**

KAVA, the root of Piper methysticum, a decoction of which is used by the natives of the Pacific Islands as a beverage, contains an essential oil, a resin and a neutral crystalline kavahin. It possesses a depressant action on the nervous system after a slight initial stimulant effect, is slightly diuretic and has been incorporated with other volatile oils into a proprietary antigonorrhœal preparation.

KIDNEY, drugs acting on. See under **Diuretics, Antiseptics (urinary).**

KINO, the dried juice of Pterocarpus, *gr.* 5–20 (0·3–1·2 *Gm.*). See under **Astringents.**

KOLA NUT contains caffeine and theobromine. See under **Caffeine.**

KOUSSO, syn. Cusso (q.v.).

KRAMERIA, syn. Rhatany, the root of various species of krameria. See under **Astringents.**

LABURNUM contains an alkaloid, cytisine, which belongs to the nicotine group.

LAMELLÆ. See under **Pharmacopœial preparations.**

LAUDANINE. See under **Opium.**

LAUROCERASI FOLIA, cherry-laurel leaves, a source of **Prussic acid** (q.v.).

LAXATIVES. See under **Purgatives.**

LEAD possesses all the actions of the **heavy metals** (q.v.), and the therapeutic use of lead is simply an application of the general action of this group. Externally applied in the form of a lotion for inflamed surfaces a lead albuminate, which is insoluble in excess of albumen and in NaCl solution, is formed; and this acts as a protection to subjacent tissues. The lead ion is less toxic to tissues generally than is the mercury ion. **Absorption** is slow in the form of albuminate; **excretion** is slower still, so that cumulative effects are common. Internally it is used, mainly in conjunction with opium, to allay diarrhœa; this again it does by its direct astringent action on the mucous membrane of the intestine. The symptoms of **acute lead poisoning** are mainly due to direct irritant action on the stomach—nausea, vomiting, etc. Albumen or simple sulphates may be given as antidotes, forming the insoluble albuminate or sulphate of lead in the stomach, which are not readily absorbed. In **chronic lead poisoning,** on the other hand, the symptoms are produced on various tissues mainly after absorption; such symptoms are frequently seen in painters and others whose work involves the handling of lead or of products containing it. Chronic lead poisoning has occurred, too, in epidemic form, often owing to a faulty water supply—e. g. in the Glasgow epidemic, where old lead pipes were used for conducting a soft water supply. The chief symptoms of chronic poisoning are anæmia, a metallic taste in the mouth, blue line on the gums, colic—frequently with constipation—peripheral neuritis with paralysis of the extensors, particularly of the upper limb (the supinator longus usually escapes). All forms of plain muscle are liable to be stimulated—great increase in tonus rather than increased movements resulting—thus abortion may take place in lead poisoning. Striped muscle affected by lead is very easily fatigued. Potassium iodide is the usual antidote—a double salt being formed in the tissues, which is more easily excreted than the insoluble lead albuminate.

LEMON. See under **Volatile oils.**

LINIMENTA. See under **Pharmacopœial preparations.**

LIQUORES. See under **Pharmacopœial preparations.**

LIQUORICE, syn. Glycyrrhiza, the root of Glycyrrhiza glabra, *gr.* 5–20 (0·3–1·2 *Gm.*). See under **Demulcents.**

LITHIUM. Salts of lithium are absorbed with great rapidity; they are somewhat irritant, and so are liable to produce nausea and vomiting. Like potassium, lithium depresses all forms of muscle. Excretion takes place fairly rapidly, mainly in the urine, also in the saliva and gastric and intestinal mucus. Irritation of the alimentary canal with vomiting and purgation may take place during excretion. Lithium was at one time used as a solvent of uric acid in the treatment of gout. Lithium acts as such a solvent, but only in concentrations never reached in the tissues after therapeutic doses.

LOBELINE, an alkaloid obtained from lobelia inflata, preparations of which are widely used in asthma remedies, has a pharmacological action closely resembling that of **nicotine** (q.v.).

LOGWOOD, syn. Hæmatoxylon. See under **Astringents.**

LOTIONES. See under **Pharmacopœial preparations.**

LYSOL. See under **Antiseptics.**

LYTTA, syn. Cantharides. See under **Irritants.**

MAGNESIUM salts owe their chief action to their slowness of absorption when given by the mouth; they are absorbed hardly at all, and so produce osmosis, attracting water from the tissues into the intestine. See also under **Osmosis** and **Purgatives.** If injected into the blood-stream, magnesium has a depressant action on the heart, on plain muscle and on the CNS.

MALE FERN, syn. Filix mas. See under **Anthelmintics.**

MANDRAKE, syn. Mandragora, contains alkaloids of the atropine group.

MANNITOL HEXANITRATE, $CH_2ONO_2(CHONO_2)_4CH_2ONO_2$, *gr.* 1 (0·06 *Gm.*). See under **Nitrites.**

MARSHMALLOW, syn. Althæa. See under **Demulcents.**

MEDINAL, the sodium salt of veronal, *gr.* 5–10 (0·3–0·6 *Gm.*). See under **Hypnotics.**

MENTHOL, *gr.* ½–2 (0·03–0·12 *Gm.*), a stearoptene. See under **Volatile oils.**

MERCURY possesses the general actions of the **heavy metals** and certain special actions as well. It is toxic to all forms of protoplasm, and its soluble salts, particularly mercuric chloride ($HgCl_2$) and iodide, are used as **antiseptics.** A 1–1000 solution of the chloride is strong enough to kill all forms of micro-organism. (See also under **Antiseptics.**) Mercury vapour is absorbed to a certain extent by the lungs and by the skin. Mercurous chloride (Hg_2Cl_2) is insoluble, and is to all intents not absorbed from the gastro-intestinal tract. When given by the mouth its action is limited to the mucous membrane of the alimentary canal. (See also under **Purgatives.**) Calomel does not act as a cholagogue; the greenish colour of the stools after calomel is due not to an increase in the amount of bile present, but to the fact that the contents are hurried through the bowel, and in consequence less time is available for the normal breaking down of the bile-pigments; further, some inhibition in the activity of micro-organisms concerned in this breaking-down process is produced. If a soluble mercuric salt be taken by the mouth **absorption** is rapid, and in addition to nausea and vomiting (produced by the direct irritant action on the stomach) symptoms produced by the drug after absorption are met with—paralysis and tremors, particularly of the facial muscles and upper extremities, fatty degeneration of viscera, salivation, fœtid breath and ulceration of the gums (excretion in saliva)—colic and diarrhœa (excretion by large intestine)—nephritis (excretion by the kidneys). **Excretion** on the whole, is slow, the metal tending to remain in the tissues fixed in combination with albumen. In acute poisoning the usual treatment is albumen followed by an emetic (not salt and water). The albuminate of mercury is soluble in excess of albumen and in NaCl solution. (Cf. lead.) In chronic poisoning potassium iodide hastens elimination similarly to the way in which it acts in chronic lead poisoning (q.v.).

Mercury is said to possess a " specific " action in **syphilis,** though there is, of course, no true specificity against the spirochæte. It acts, no doubt, as a general protoplasmic poison on the protoplasm of the spirochæte as on that of the host, and its effect on the spirochæte is probably intensified by the fact that the metal after absorption is stored up in the tissues, and so is readily available to attack the parasite. Mercury may be given in all stages of the disease either externally by direct application of a lotion or ointment to the primary sore, by inunction through the skin, by vapour baths, or internally by the mouth or by injection, particularly by the intramuscular route. Mercuric chloride (corrosive sublimate), *gr.* 1/32–1/16 (0·002–0·004 *Gm.*).

Mercurous chloride (calomel), *gr.* ½–5 (0·03–0·3 *Gm.*).

MESCAL (anhalonium) contains narcotic alkaloids of the opium class.

MESOTAN, methoxymethylsalicylate, introduced as a substitute for oil of wintergreen. See under **Salicylates.**

METHANE SERIES. See under **Hypnotics.**

METHYL SALICYLATE, syn. Oil of Wintergreen. See under **Salicylates.**

METHYL SULPHONAL, syn. Trional. See under **Hypnotics.**

MISTLETOE contains a volatile alkaloid, guipsine (q.v.).

MISTURÆ. See under **Pharmacopœial preparations.**

MONKSHOOD, syn. Aconite, contains an alkaloid, aconitine (q.v.).

MORPHINE, an alkaloid obtained from opium (q.v.).

MUCILAGINES. See under **Pharmacopœial preparations.**

MUSCARINE, an alkaloid obtained from certain fungi; it has a pharmacological action similar to that of pilocarpine (q.v.).

MUSCLE, drugs acting on. Various drugs possess a noteworthy action on the different forms of muscle—striped, plain or cardiac. Drugs are said to act directly on the muscle tissue as opposed to nerve-endings or myoneural junctions, when their action is unaltered by such drugs as atropine, ergotoxine, apocodeine, curare, which paralyse the nerve-endings and myoneural junctions. Drugs which stimulate muscle, increasing the tonus and sometimes the movements, are **barium, calcium, veratrine.** Those which depress muscle, lowering the tonus, are **potassium, chloroform, nitrites.** Some drugs have peculiar actions on certain forms of muscle, thus **caffeine** relaxes the plain muscle of the arterioles, stimulates cardiac muscle (particularly the excito-motor area), and after a slight initial stimulation sends striped muscle into rigor. The **nitrites** have a stronger affinity for plain muscle than for cardiac or striped muscle, though the action on all three is qualitatively the same. **Physostigmine** stimulates the muscle directly as well as the nerve-endings, producing a curious twitching of striped muscle. See also under **Seats of action.**

MUSTARD. See under **Volatile oils.**

MUSTARD GAS, syn. Dichlorethylsulphide.

MYONEURAL JUNCTIONS, drugs acting on. Certain drugs, such as **adrenalin, ergotoxine, pilocarpine, atropine,** act not on the anatomical nerve-endings nor on the end-organ (muscle or gland-cell), but on some peripheral receptor in close connection with both. These drugs produce an unimpaired response when the anatomical nerve-endings are completely degenerated after section of the post-ganglionic fibre, so that their seat of action cannot be on the anatomical nerve-ending. Again the action of pilocarpine can be completely cut out by previous application of atropine, as can the motor effects of adrenalin by ergotoxine, whilst the reaction to drugs like barium, which stimulate the muscle directly, is unimpaired. So these drugs, adrenalin, pilocarpine, etc., cannot be said to act on the muscle in the sense in which drugs of the barium class act on it. The term myoneural junction has, therefore, been introduced to specify this intermediate receptor. See also under **Seats of action.**

MYRISTICA, nutmeg. See under **Volatile oils.**

MYRRH, a gum-resin obtained from balsamodendron myrrha. See under **Volatile oils.**

NAPHTHOL, $C_{10}H_7OH$. α-naphthol is more irritant than β-naphthol; both are strongly antiseptic.

α-naphthol, *gr.* 2–5 (0·12–0·3 *Gm.*).

β-naphthol, *gr.* 3–10 (0·2–0·6 *Gm.*).

See also under **Antiseptics.**

NARCEINE, an alkaloid obtained from opium (q.v.).

NARCOPHINE, morphine narcotine meconate, *gr.* 1/3–1/2 (0·02–0·03 *Gm.*). See under **Opium.**

NARCOTICS, drugs producing a condition of coma, take a place intermediate between the hypnotics on the one hand, and the anæsthetics on the other. They consist mainly of the opium alkaloids, cannabis, though in large doses members of the hypnotic group might be termed narcotics, as too might small doses of the general anæsthetics and submaximal doses of alcohol. See also under **Opium, Anæsthetics, Hypnotics.**

NARCOTINE, *gr.* 1–3 (0·06–0·2 *Gm.*), an alkaloid obtained from opium (q.v.).

NEOSALVARSAN, average dose *gr.* 10–12 (0·7–0·8 *Gm.*). See under **Arsenic.**

NERVE-ENDINGS, action of drugs on. Certain drugs which act peripherally to the ganglion-cells on the autonomic system may have their actions cut out by section and degeneration of the post-ganglionic fibres, though drugs which act on the muscle directly still retain their action unimpaired. **Physostigmine** is such a drug; its action is not impaired when the ganglion-cells are paralysed with nicotine, but it is entirely abolished (in so far as its action on nervous elements is concerned; it has in addition an action on the muscle direct) either after degeneration of the nerve-endings or after paralysis of the nerve-endings with atropine, apocodeine or curare. See also under **Seats of action.**

NICOTINE is a volatile liquid alkaloid obtained from tobacco and also from duboisia. The most interesting pharmacological action of nicotine is on **ganglion-cells.** These both on the sympathetic and cranio-sacral autonomic are depressed and eventually paralysed after an initial stimulation. In addition motor nerve-endings are paralysed, and the CNS is rendered more irritable, increased reflexes and even convulsions occurring. It has been estimated that smoke from tobacco contains about 1·5 per cent. of nicotine with other **pyridine** compounds. Tolerance is easily acquired, more readily in man than in animals. Other drugs belonging to the same group and possessing similar actions, differing from those of nicotine in degree only, are **lobeline, coniine, gelseminine, sparteine.** See also under **Seats of action.**

NIRVANINE. See under **Cocaine.**

NITRATES possess a salt action (q.v.) and in addition are somewhat irritant, so that when given by the mouth they may produce nausea, vomiting and diarrhœa. They are absorbed very readily from the small intestine, so that such salt action as is induced is mainly in the direction of increased diuresis rather than of purgation. A small amount of nitrate is decomposed in the tissues, the nitrogen being excreted by the lungs; the remainder circulates unchanged and is excreted mainly in the urine, some in the sweat—diuresis and diaphoresis are induced during excretion. Potassium nitrate (saltpetre) is used in the preparation of asthma powders; whilst smouldering, oxygen is given off, thus helping the combustion to continue and at the same time nitrite is formed, which may help the other volatile ingredients to dilate the bronchioles.

NITRITES. The characteristic pharmacological action of the nitrites is depression of all forms of muscle. Plain muscle, particularly of the arterioles, is more especially affected, cardiac and striped muscle being less sensitive; but the effect on these is qualitatively the same. That the nitrites act directly on muscle and not through the innervation is easily shown (a) by the fact that they act just as well when all the innervation including myoneural junctions is paralysed by some drug such as apocodeine, or when the nerves are completely degenerated; (b) by the fact that perfusion of vessels such as the pulmonary, which contain little or no vasomotor innervation, produces the same effect as perfusion of vessels, like those in the splanchnic area, which contain a very active innervation. The main effect of the nitrites, then, is depression and relaxation of tonus of all plain muscle—arterioles, bronchioles, uterus, intestine, etc. Most of the other effects, such as quickening of the heart, respiratory changes, increased glandular secretions, are secondary to the fall in blood-pressure or to local vasodilatation. Amyl and ethyl nitrites act rapidly, and their effects are evanescent; erythrol tetranitrate is slow in action with a prolonged period of reaction; the other members of the series are intermediate.

NITROGLYCERIN, *gr.* 1/200–1/50 (0·0003–0·0013 *Gm.*), a thick oily liquid (note that the official dose is in solid measure). See under **Nitrites.**

NITROUS OXIDE, N_2O, is used as a general anæsthetic mainly for short operations. When inhaled it is very rapidly absorbed into the circulation from the pulmonary alveoli; it depresses the CNS from above downwards, essentially in the same way as do chloroform and alcohol (q.v.). Beyond this asphyxia is produced—the gas is not dissociated at body-temperature to afford free oxygen. If, however, oxygen be administered along with the nitrous oxide under pressure, asphyxia is not produced and a prolonged anæsthesia may be maintained. There is much less depression of the heart with nitrous oxide than with chloroform or ether, and it is by far the safest general anæsthetic at our disposal.

NOVOCAINE. See under **Cocaine.**

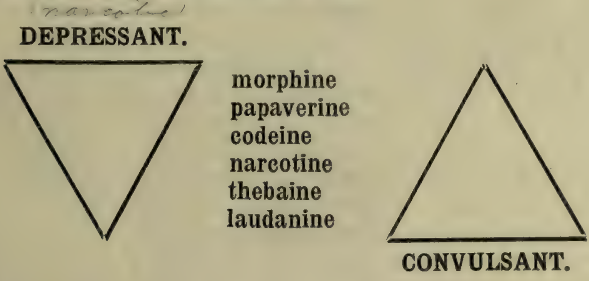
NUTMEG, syn. Myristica. See under **Volatile oils.**

NUX VOMICA, the seed of strychnos nux vomica, contains alkaloids, strychnine and brucine, *gr.* 1–4 (0·06–0·25 *Gm.*). See under **Strychnine.**

OLEA. See under **Pharmacopœial preparations.**

OMNOPON. A proprietary preparation said to contain all the alkaloids without the other constituents of opium (q.v.).

OPIUM, the dried juice of papaver somniferum, *gr.* $\frac{1}{2}$–2 (0·03–0·12 *Gm.*). Opium contains a number of alkaloids, the most important of which are **morphine, codeine, papaverine, thebaine, narcotine, laudanine,** together with meconic acid, resins and other substances. Chemically the opium alkaloids fall into two distinct groups: (a) the pyridin-phenanthrene group (morphine, codeine, thebaine, etc.), (b) the benzyl-isoquinoline group (papaverine, narcotine, narceine, etc.). All the alkaloids possess a depressant action on nerve-cells and a convulsant action, not unlike that of strychnine; morphine has the maximum of depressant with the minimum of convulsant effect, whilst at the other end of the scale comes laudanine with maximum convulsant and minimum depressant action, the remaining alkaloids being intermediate, thus—



A preparation of opium containing relatively large amounts of laudanine and a relatively small amount of morphine is thus liable to produce convulsant rather than sedative effects. Again, certain species, and perhaps certain individuals of a species, may show peculiar responses: for example, cats are thrown into a condition of wild excitement by morphine—the least excitant alkaloid of the series.

Morphine is by far the most important of these alkaloids. Its effect on the **CNS** is rather similar to that of chloroform or of alcohol—that is to say, it depresses from above downwards—but whereas alcohol and chloroform depress motor and sensory cells about equally, morphine has a more profound action on sensory cells. After large doses the medulla becomes depressed or even paralysed, and death after a poisonous dose results from paralysis of the respiratory centre, frequently preceded by a Cheyne-Stokes type of respiration. **Peripherally** morphine has no action on nerve-endings either motor or sensory, so that local applications are not only useless but irrational. The **special senses** are somewhat dulled in acuity from a central action. **Secreting glands** are hardly affected except the **sweat-glands;** usually some increase in perspiration is seen following on a cutaneous vasodilatation (medullary). With the exception of these surface vessels there is little or no effect on the **cardio-vascular system.** (Certain alkaloids of the series, more particularly apocodeine and apomorphine, produce splanchnic vasodilatation from depression of sympathetic nerve-cells; this action in the case of morphine is barely perceptible.) On the **intestine** two entirely different effects may be produced : (a) if morphine is applied directly to the gut, all peristaltic movements cease; the drug paralyses some part of the peripheral nervous mechanism, possibly of Auerbach's plexus. This effect in a mild degree is commonly seen in therapeutics; morphine is excreted from the tissues largely by the bowel, and in its passage into the lumen of the gut it produces this depression of peristalsis; constipation is a common accompaniment of morphine medication. (b) If a large dose of morphine is injected intravenously, certain sympathetic nerve-cells are paralysed, with the result that normal sympathetic (inhibitor) impulses fail to reach the intestine; the motor vagus therefore acts unchecked, with the result that increased intestinal movements and purgation take place. This effect is not seen in therapeutics, and it occurs only when a high concentration of the drug is in the circulation; this effect is produced far more easily by apocodeine. **Metabolism** is slowed; oxygen intake is diminished to a greater extent than CO_2 output. **Excretion** is mainly by the intestine; about 70 per cent. of a given dose can be recovered from the fæces unchanged, the remainder is destroyed in the tissues. If an animal is made to become habituated to morphine an increasingly smaller amount can be recovered from the excreta; the tissues are becoming more competent to destroy the drug. This increased power of the tissues to destroy morphine is the reason of the **tolerance** and of the enormous quantities that can be taken, and which become necessary to produce an effect in those who have acquired a morphine habit.

The contracted **pupil** caused by morphine is due to some central action; no effect is produced on the pupil by instilling the drug into the conjunctival sac.

Morphine, *gr.* 1/10–1/3 (0·006–0·02 *Gm.*).

Codeine, *gr.* $\frac{1}{4}$–2 (0·016–0·12 *Gm.*).

Apomorphine, *gr.* 1/10 (0·006 *Gm.*) for hypodermic injection. See under **Emetics.**

OPTOQUIN, syn. Ethylhydrocupreine. See under **Quinine.**

ORANGE. See under **Volatile oils.**

ORDEAL BEAN, syn. Calabar bean, contains an alkaloid, **Physostigmine** (q.v.).

OSMOSIS, the physical phenomenon to which salt-action is due. If two saline solutions of different molecular content are separated only by a semipermeable membrane, water is attracted from the solution of low concentration to the solution of high concentration until the two solutions are equimolecular, when the process ceases. Salts which ionise exert an osmotic pressure equivalent not to the number of molecules of the salt, but equivalent to the number of ions into which the molecules dissociate (see under **Ions**). Though not in the strict sense semipermeable membranes (which allow the solvent but not the substance held in solution to pass), various body-tissues may be regarded as being to a certain extent semipermeable, so that if, for example, a hypertonic solution of a salt is placed in the lumen of the bowel, water is attracted from the tissues into the gut until the originally hypertonic solution is rendered isotonic. Similarly, if a hypertonic solution finds its way into the circulation, fluid is attracted thereto. Catharsis and diuresis respectively result in the two cases, and it is probable that the whole of the action of a saline purgative and a large part of the action of a saline diuretic depends on this process of osmosis. It follows that the ideal saline purgative must be a salt (such as magnesium sulphate) which is absorbed little or not at all from the gastro-intestinal tract; *per contra* the essence of a saline diuretic is that when given by the mouth it is readily absorbed into the tissues.

OUABAINE, an alkaloid obtained from acocanthera, identical with g-strophanthin. See under **Digitalis.**

OXALATES have a strong chemical affinity for **calcium;** in consequence of this—by precipitating the tissue-calcium—they act as general protoplasmic poisons, weakening and eventually stopping the beat of the heart, rendering all organs inactive and inhibiting the action of ferments. Oxalates are not used in therapeutics; but certain vegetable foods, such as tomatoes, rhubarb and strawberries, contain these salts. They are excreted in the urine as calcium oxalate, which may give rise to attacks of renal or ureteral colic. Treatment of oxalate poisoning consists in administration of calcium salts (to save precipitation of tissue-calcium) and of free draughts of water (to flush out the urinary passages and so to prevent blocking of these with deposits of the crystals of calcium oxalate.

OXYMELLA. See under **Pharmacopœial preparations.**

PANAMA BARK, syn. Quillaia bark. See under **Saponins.**

PANTOPON, syn. Omnopon (q.v.).

PAPAIN, a proteolytic ferment found in the fruit of the Papaya or Pawpaw.

PAPAVERINE, an alkaloid obtained from opium (q.v.).

PARAFFIN. See under **Purgatives** and **Pharmacopœial preparations.**

PARAHYDROXYPHENYLETHYLAMINE, syn. Tyramine. See under **Ergot.**

PARALDEHYDE, $C_6H_{12}O_3$, ♏ 30–120 (2–8 c.c.). See under **Hypnotics.**

PARAMIDOPHENOL. See under **Antipyretics.**

PELLETIERINE, an alkaloid obtained from pomegranate. See under **Anthelmintics.**

PENNYROYAL, syn. Pulegium. See under **Volatile oils.**

PEPPER. See under **Volatile oils.**

PEPPERMINT. See under **Volatile oils.**

PEPSIN, *gr.* 5–10 (0·3–0·6 *Gm.*), a proteolytic ferment obtained from the gastric mucous membrane of pigs, sheep and calves.

PERIPHERAL RECEPTORS, drugs acting on. Drugs which produce a response by virtue of a peripheral action may act (a) directly on the plain muscle or gland-cell (end-organ), e. g. **barium,** (b) on the myoneural junction, e. g. **pilocarpine, adrenalin,** (c) on the anatomical nerve-ending, e. g. **physostigmine, curare,** (d) on the ganglion-cell, e. g. **nicotine,** (e) on the trunk of a nerve, e. g. **cocaine.** See also under **Seats of action.**

PERMANGANATES. See under **Antiseptics.**

PERONINE, syn. Benzyl morphine, an artificial combination of morphine. See under **Opium.**

PEROXIDE OF HYDROGEN, ʒ ½–2 (2–8 c.c.). See under **Antiseptics.**

PERTUSSIN, a proprietary remedy for whooping-cough, containing an extract of thyme. See under **Volatile oils.**

PHARMACOPŒIAL PREPARATIONS:—

Aceta. Acetic acid extracts, ♏ 5–15 (0·3–1 c.c.) (except acetum cantharidini, which is not taken internally).

Aquæ. Aqueous solutions of volatile oils, ℥ 1–2 (30–60 c.c.) (except aqua laurocerasi, ʒ ½–2 (2–8 c.c.)).

Collodia. Solutions essentially of pyroxylin in a volatile solvent such as ether. Not taken internally.

Confectiones. Sugary pastes *gr.* 60–120 (4–8 *Gm.*).

Decocta. Solutions of constituents of crude drugs prepared by boiling in water and straining, ℥ ½–2 (15–60 c.c.).

Emplastra. Plasters made by embodying the drug in a sticky medium which is then spread on a basis of thin leather, silk or similar material. The adhesive medium consists of either oleate of lead, glycerin, resin, animal fat or beeswax.

Extracta. Made by evaporating the juice of a plant or by making a solution of dry active principles and subsequently evaporating. Extracts are (a) **solid,** doses varying from *gr.* ¼–1 (0·016–0·06 *Gm.*) to *gr.* 5–15 (0·3–1·0 *Gm.*), (b) liquid, doses varying from ♏ ½–2 (0·03–0·12 c.c.) to ʒ 1–2 (4–8 c.c.).

Glycerina. Solutions or suspensions of drugs in glycerin; mostly not taken internally.

Infusa. Solutions made by pouring boiling water on the crude drug and straining. ℥ ½–1 (15–30 c.c.)—(except infusum digitalis ʒ 2–4 (8–16 c.c.)).

Injectiones. Strong aqueous solutions for hypodermic injection; strychnine 0·75 per cent., apomorphine 1 per cent., morphine 2·5 per cent., cocaine 5 per cent., ergot 33 per cent.

Lamellæ. Discs with a basis of gelatin and glycerin in which the drug is incorporated; used for conjunctival application.

Linimenta. Oily or alcoholic solutions for external application.

Liquores. Solutions of drugs usually in water, some for external application only, others for internal administration. The doses of the latter vary widely according to the potency of the drug from ♏ ½ (0·03 c.c.) in the case of liquor trinitrini to ℥ 1–4 (30–120 c.c.) in the case of liquores calcis and magnesii bicarbonatis.

Lotiones. Watery solutions for external application.

Mella. Drugs incorporated into a basis of honey.

Misturæ. Solutions or suspensions of drugs in water, ℥ ½–1 (15–30 c.c.).

Mucilagines. Watery solutions or suspensions of gummy substances, used for helping the suspension in water of insoluble drugs.

Olea. Fixed and volatile oils of natural source, except oleum phosphoratum which is a solution of phosphorus in almond oil. The doses vary from ♏ ½–1 (0·03–0·06 c.c.) in the case of oleum crotonis to ʒ 6 (24 c.c.) in the case of olea ricini and morrhuæ.

Oxymella. Preparations of drugs in a basis of honey and acetic acid, ʒ ½–1 (2–4 c.c.).

Pilulæ. Pills consisting of drugs incorporated in some basis such as soap, glycerin, tragacanth or syrup, which makes the required consistency. If at all sticky the pill-mass is coated with silver paper or with a powder in order to prevent the separate pills from adhering to each other. If coated with keratin the pill passes through the stomach untouched and the drug does not act till the keratin coat is dissolved in the duodenum, *gr.* 4–8 (0·25–0·5 *Gm.*), (except pilula phosphori *gr.* 1–4 (0·06–0·25 *Gm.*) and pilulæ plumbi cum opio and saponis composita *gr.* 2–4 (0·12–0·25 *Gm.*)).

Pulveres. Drugs in the form of a fine powder. The doses vary between *gr.* 3–6 (0·2–0·4 *Gm.*) in the case of pulvis antimonialis and *gr.* 60–120 (4–8 *Gm.*) in the case of pulvis glycyrrhizæ compositus.

Spiritus. Alcoholic solutions of drugs, ♏ 5–20 (0·3–1·2 c.c.).

Except spiritus chloroformi ♏ 5–40 (0·3–2·5 c.c.).
,, ,, ætheris
,, ,, ,, nitrosi
,, ,, ammoniæ aromaticus
,, ,, ammoniæ fetidus
,, ,, armoraciæ compositus
♏ 20–90 (1·2–6·0 c.c.).

Succi. Juices of plants to which alcohol is added as a preservative, ʒ 1–2 (4–8 c.c.).

Suppositoria. Incorporations of drugs in a basis either of oil of theobroma or of gelatin, shaped for easy introduction into a mucous orifice, where the basis melts and leaves the drug as a local application to the mucous membrane.

Syrupi. Sugary liquid preparations of drugs, ʒ ½–1 (2–4 c.c.) (with certain exceptions which may be given up to ʒ 2 (8 c.c.)).

Tabellæ. Tablets with a chocolate basis, t. trinitrini containing *gr.* 1/130 of nitroglycerin.

Tincturæ. Alcoholic solutions of active principles of drugs. Tinctures of potent drugs have a dose of ♏ 5–15 (0·3–1·0 c.c.) (except tincturæ aconiti, cantharidini, iodi mitis and strophanthi, ♏ 2–5 (0·12–0·3 c.c.)); tinctures of non-potent drugs have a dose of ʒ ½–1 (2–4 c.c.); tincturæ iodi fortis and pyrethri are not used internally.

Trochisci. Lozenges of drugs incorporated in a solid basis with some fruit paste, gum acacia or tolu.

Unguenta. Ointments of drugs incorporated with a fatty or oily basis such as lard, paraffin, wax or olive oil; not used internally.

Vina. Preparations similar to tinctures except that extraction is made with sherry or orange wine in the place of the stronger alcohol of the tinctures. The doses vary from ♏ 10–30 (0·6–1·8 c.c.) to ℥ ½–1 (15–30 c.c.).

PHENACETIN. See under **Antipyretics.**

PHENAZONE, syn. Antipyrin. See under **Antipyretics.**

PHENETIDIN. See under **Antipyretics.**

PHENOL, syn. Carbolic acid. See under **Antiseptics.**

PHENOLPHTHALEIN. See under **Purgatives.**

PHENYL QUINOLINE CARBONIC ACID, syn. Atophan (q.v.).

PHOSPHATES have no specific actions and their effects are due mainly to salt action. They are **absorbed** slowly from the gastro-intestinal tract, and in consequence they possess some cathartic action when taken by the mouth. See also under **Purgatives.**

PHOSPHORUS, *gr.* 1/100–1/25 (0·0006–0·0025 *Gm.*). Yellow phosphorus is more toxic than red, the difference being referable to their different solubilities and rates of absorption when given by the mouth. It is an irritant to the **gastro-intestinal tract,** producing nausea, vomiting and colic. **Absorption** takes place from the small intestine, where absorption is rendered easier by the presence of fats and the alkaline reaction. It gives rise to a greatly increased **break-down of proteins,** and later to a **fatty degeneration** of most tissues, particularly of the liver. There is no noteworthy action on the cardio-vascular system until the appearance of fatty changes and a consequent enfeeblement of the heart's action. Phosphorus increases the activity of bone formation, and produces a tendency for more compact bone to be formed at the expense of the cancellous bone. The symptoms of phosphorus **poisoning** are referable (1) to the direct irritant action on the gastro-intestinal tract; (2) to the subsequent fatty changes.

Amongst phosphorus workers a peculiar symptom is "phossy jaw," an osteitis set up originally by the direct irritant action on the gums and exposed periosteum, and later complicated by bacterial action, the diseased bone being easily attacked particularly by the tubercle bacillus. Treatment of phosphorus poisoning consists in emptying the stomach by an emetic or by washing out with permanganate solution (formation of phosphoric acid). Turpentine combines with phosphorus with the formation of an insoluble non-toxic body. **Avoid oils which hasten the absorption.**

PHYSOSTIGMINE, syn. Eserine, *gr.* 1/100–1/50 (0·0006–

0·0012 *Gm.*), an alkaloid obtained from calabar bean, which contains also other alkaloids, eseramine and eseridine. In general physostigmine has an action similar to that of **pilocarpine** (q.v.). In addition to this action on peripheral nerves however, physostigmine has some action on the muscle (end-organ) directly, and the action on the nerve seems to be on the anatomical nerve-ending rather than on the myoneural junction. (Cf. pilocarpine.) That is to say, degeneration of the post-ganglionic fibre prevents the nervous action of physostigmine—as, too, does previous atropinisation—though such action as is direct on the muscle remains in either case. **Striped muscle** is thrown into twitchings by physostigmine and is rendered more sensitive to stimuli. The first effect appears to be referable to a stimulant action on motor nerve-endings, since it is abolished by curare, though the increased irritability remains. **Plain muscle** is affected in much the same way, the gross effect being increased tonus and exaggerated movements. The **heart** beat is strengthened and slowed. **Vasoconstriction** is produced in which the pulmonary circulation shares. The **CNS** is depressed, the depression working from below upwards; consequently in cases of poisoning the intellect remains clear at a time when the respiratory centre is becoming paralysed. **Excretion** is mainly in the urine, some of the drug is destroyed in the tissues.

PICROTOXIN, an indifferent body obtained from Anamirta, with a stimulant action on the CNS, producing convulsions like strychnine.

PILOCARPINE, *gr.* 1/20–1/3 (0·003–0·02 *Gm.*), a thick colourless liquid alkaloid obtained from the leaves of Jaborandi, which, as its **general action** stimulates the peripheral myoneural junctions of autonomic nerves, particularly of the cranio-sacral autonomic, though in certain organs innervated only by the sympathetic the myoneural junctions of this system are stimulated in precisely the same way.

Outside the body, if applied to a mucous surface, local absorption takes place; it is not absorbed through the intact skin. When taken by the mouth **absorption** is rapid from the stomach and small intestine, and local actions are produced on the mucous membranes of mouth, œsophagus and stomach—an increased mucous secretion in each case. The tonus and automatic movements of **plain muscle** are increased with a very few exceptions. The secretion of all **secreting glands** is increased, including the sweat glands (sympathetic innervation). The **pupil** is constricted (stimulation of the third cranial nerve); **accommodation** is at the same time fixed for near vision (stimulation of the ciliary nerve), and intraocular pressure is diminished. The **bronchioles** are constricted and an increased flow of bronchial mucus results (stimulation of the vagus). The **heart** is slowed, a long diastolic pause resulting—some small diminution in amplitude of the beat takes place at the same time (stimulation of the vagus). **Vasoconstriction** of splanchnic vessels and dilatation of surface vessels take place; the former from stimulation of sympathetic, and the latter secondary to the increased activity of sweat and other skin glands. **Blood-pressure** is markedly lowered; the cardiac slowing with consequent diminished cardiac output is intense and quite overcomes the comparatively small degree of vasoconstriction. A **lymphocytosis** is produced; contraction of the plain muscle of spleen and lymphatic glands squeezes out the corpuscles into the circulation. The **gastro-intestinal tract** is thrown into a state of increased movements and heightened tonus (stimulation of the vagus); the secretions of the mucous glands are at the same time increased, frequent watery stools resulting. The effect on the **uterus** is usually an increase in tonus and in movements; in a few cases, however, the uterine movements and tonus are inhibited (e. g. the uterus of the virgin cat), the uterus obtains its innervation entirely from the sympathetic system, which in the case of the virgin cat's uterus is predominantly inhibitor in function. The flow of **urine** is reduced: this effect appears to be secondary to the greatly increased loss of fluid by secreting glands rather than to any direct action on the kidney. The **suprarenal glands** are said to be stimulated, an increased outpouring of adrenalin resulting. The **CNS** is slightly stimulated at first, and this is followed by a secondary depression; this central action is insignificant compared with the peripheral actions. **Excretion** takes place mainly in the urine, some of the drug is destroyed in the tissues.

The effects described are those which follow an intravenous injection into an animal. It frequently happens, however, that when given by the mouth a rise in blood-pressure and a quickening of the heart result. Again, in spite of what is stated above, pilocarpine was at one time used in the treatment of acute spasmodic asthma, to dilate the bronchioles. It may be that in the comparatively low concentration in which the drug reaches the tissues when given by the mouth, the sympathetic rather than the cranio-sacral autonomic is stimulated (= acceleration and augmentation of the heart constriction of blood-vessels, dilatation of bronchioles), or, according to another explanation, such small concentrations affect the suprarenals in a more intense manner than the peripheral cranio-sacral autonomic innervation, and the cardiac acceleration, the vasoconstriction and the broncho-dilatation are then due to the outpouring of the animal's autogenous adrenalin. See also under **Seats of action.**

PILULÆ. See under **Pharmacopœial preparations.**

PIPERAZINE, syn. Diethylenediamine, *gr.* 5–10 (0·3–0·6 *Gm.*), a powerful solvent in vitro of **uric acid;** consequently it has been used in the treatment of gout. In vivo the necessary concentration in the tissues cannot be obtained and the drug is useless as a uric acid solvent.

PITUITRIN, the active principle (nature unknown) of the posterior lobe (pars intermedia and pars nervosa) of the pituitary gland, In **substitution therapy** extracts of whole pituitary gland are of use in hypopituitarism (dystrophia adiposo genitalis), but they are usually considered to be contraindicated in acromegaly (hyper- or dys-pituitarism). On the assumption that the pituitary and thyroid glands are to an extent reciprocal, pituitary gland extracts are used in certain cases of hyperthyroidism. The activity of the pituitary gland is closely connected with calcium metabolism; when the organism has need of calcium retention, as in pregnancy, the pituitary gland undergoes hyperplasia and increases in activity. Similarly an enlarged pituitary is found in acromegaly, a disease characterised by greatly increased bone formation with deposition of calcium. On the other hand, in hypopituitarism one finds a dwarfish condition with ill-developed bones and genital organs.

The immediate pharmacological actions of pituitrin cannot be referred to stimulation or depression of any recognised receptor. (Cf. adrenalin and sympathetic myoneural junctions.) Its action is obviously on some peripheral structure; the same effect is produced on an isolated organ as on that organ in the intact animal. Its action can be described generally as one of increasing the tonus of plain muscle. It has this effect on the intestine and, therefore, cannot act by stimulation of the sympathetic: it dilates the pupil of the enucleated eye of the frog and, therefore, its action cannot be ascribed to stimulation of the craniosacral autonomic; it is usually said to stimulate plain muscle directly, but there are certain tracts of plain muscle which fail to give any response to pituitrin (e. g. the vas deferens of most animals); again it causes diarrhœa and not constipation, whereas drugs, like barium, which directly stimulate plain muscle, cause all plain muscle to contract and produce constipation rather than diarrhœa. Also drugs which directly stimulate plain muscle usually constrict the pupil—the circular and radial fibres are stimulated equally and at the same time, and the circular acting at a greater mechanical advantage get the better of the radial, and constriction results.

In the **stomach** pituitrin is not changed; it is destroyed in the duodenum. **Blood-vessels** are constricted with a few exceptions (the renal vessels usually dilate). The **heart** beat is strengthened and somewhat slowed. **Blood-pressure** is raised, usually after an initial transient fall which may be due to the presence of histamine in the extract. In most animals a so-called tachyphylactic effect is produced; if several injections of pituitrin are given at short intervals, the rise in blood-pressure becomes less and less after succeeding doses, and frequently the rise becomes obliterated altogether and the pressure actually falls. **Bronchioles** are constricted; the **intestine** is less sensitive to pituitrin than are most tracts of plain muscle, but in most animals the ileum at any rate is thrown into a state of increased movements and heightened tonus (diarrhœa is a frequent sequela of pituitrin injection in the human subject). The **uterus** is stimulated to increased tonus in all states. The secretion of the active **mammary gland** is increased; this is a temporary effect and the daily yield of milk cannot be increased. According to Schäfer the increased flow of milk is simply the expression of preformed secretion as a result of the contraction of the plain muscle trabeculæ within the gland induced by the pituitrin. A distinct increase in **diuresis** is seen to follow an injection of pituitrin; this is probably a cardio-vascular effect (the renal vessels dilate whilst other vessels constrict and whilst blood-pressure is raised); the polyuria of **diabetes insipidus** can usually be checked by pituitrin.

As well as producing an immediate and noticeable effect on plain muscle, pituitrin apparently sensitises the muscle and renders it hypersusceptible to other stimuli. **Excretion** is by the urine.

PIX, wood-tar. See under **Antiseptics.**

PODOPHYLLUM, the rhizome of Podophyllum peltatum, contains podophyllotoxin. See under **Purgatives.**

POMEGRANATE, contains an alkaloid, pelletierine. See under **Anthelmintics.**

POTASSIUM is a general tissue depressant. If taken by the mouth its toxic effects are not seen, as it is eliminated with great rapidity. If a solution of a potassium salt is injected intravenously or perfused artificially through an organ, its toxic effects become apparent. The **heart** beat is weakened, systole being greatly diminished, the rate somewhat slowed and the heart stops in diastole. The same effect is produced if all nerve-endings are previously paralysed by atropine or apocodeine, so that the action must be a direct one on the muscle itself. The automatic movements of all **plain muscle** are stopped and the tonus is relaxed. **Striped muscle** is affected in a similar manner, usually after an apparent initial stimulation. The **CNS** is depressed by potassium. All the muscular effects of potassium may be antagonised by **calcium;** the beat of a heart which has quite stopped as a result of applying potassium may be restored by calcium. **Excretion** takes place very rapidly in the urine.

PREPARATIONS, Pharmacopœial. See under **Pharmacopœial preparations.**

PRUNES. See under **Purgatives.**

PRUNE, Virginian, a source of prussic acid (q.v.).

PRUSSIC ACID, HCN, syn. Hydrocyanic acid, is obtained from bitter almonds which contain a glucoside, amygdalin, and a ferment, emulsin. In the presence of water the emulsin splits up the amygdalin into prussic acid, benzaldehyde and dextrose. Other sources of prussic acid are cherry-laurel leaves and Virginian prune bark. The dose of the dilute (2 per cent.) prussic acid is ♏ 2–5 (0·1–0·3 c.c.).

Prussic acid is a **general protoplasmic poison,** destroying all forms of life and inhibiting fermentation and putrefaction. If applied to a mucous membrane it paralyses the peripheral nervous mechanism. It is very volatile, and in consequence is absorbed with great rapidity, whether given by inhalation, by the mouth or by injection. In the **mouth** a feeling of numbness follows a transient burning sensation. After absorption the **CNS** is stimulated at first, and then depressed and paralysed. The medulla is particularly affected; vasoconstriction, increased respiratory movements, etc., occurring for a moment, immediately followed by vasodilatation, weakening and cessation of respiratory movements. Death occurs from paralysis of the respiratory centre. At the same time as the medullary depression the **heart** muscle is depressed and the heart stops in diastole. The tissues generally are affected, so that they lose their power of taking up oxygen from the blood, which even in the venous circulation remains bright red. Hæmoglobin is changed to **cyanhæmatin** in vitro, but this change does not take place in the body. **Excretion** is in the form of sulphocyanides. Treatment in cases of poisoning must be immediate. Sodium hyposulphite intravenously has been recommended, with the idea of forming the less toxic sulphocyanide. This and medullary stimulants would appear to give the best chance, though depression of the medulla is so rapidly brought on that at best the chances are slender. Artificial respiration is usually useless, since the heart muscle is poisoned at the same time as the medulla.

PSYCHOTRINE, an alkaloid contained in ipecacuanha. See under **Emetics.**

PTEROCARPUS. The wood of Pterocarpus marsupium is the source of kino (the dried sap). See under **Astringents.**

PULVERES. See under **Pharmacopœial preparations.**

PUPIL, action of drugs on. The plain muscle of the iris consists of radial fibres innervated by the sympathetic, and of circular fibres innervated by the third cranial nerve. Drugs, then, which stimulate any part of the sympathetic innervation will dilate the pupil, whilst those which stimulate any part of the third cranial nerve will constrict the pupil. Some drugs affect the muscle directly: if both sets of muscle are stimulated equally and at the same time, constriction results, since the circular fibres act at a greater mechanical advantage than the radial.

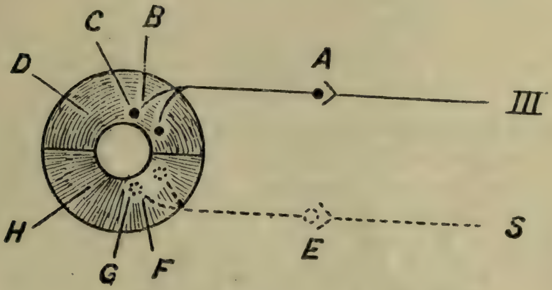


FIG. 11.

A = Ganglion-cell on motor-oculi nerve (III).
B = Nerve-ending of motor-oculi nerve.
C = Myoneural junction of motor-oculi nerve.
D = Circular muscle fibres of iris supplied by III.
E = Ganglion-cell on sympathetic (S).
F = Nerve-ending of sympathetic.
G = Myoneural junction of sympathetic.
H = Radial muscle fibres of iris supplied by S.

Drugs acting on A and E.—Nicotine + −, etc.

Drugs acting on B and C.—Pilocarpine +, physostigmine +, atropine −, etc.

Drugs acting on D and H.—Barium +, chloroform − (but the pupil reactions to $CHCl_3$ in the intact animal are referable to central effects), etc.

Drugs acting on F and G.—Adrenalin +, cocaine +, etc.

The effect of morphine on the pupil is central.

PURGATIN, a synthetic anthracene purgative. See under **Purgatives.**

PURGATIVES. Drugs which produce purgation act either (1) by increasing peristalis or (2) by increasing the fluidity of the intestinal contents. Many purgatives act in both ways. Purgatives may be classified as follows—

- (a) Mineral Purgatives.
  - 1. Salines.
  - 2. Mercury Salts.
- (b) Vegetable Purgatives.
  - 1. Laxatives.
  - 2. Oils.
  - 3. Anthracene group.
  - 4. Drastic Purgatives.

Saline Purgatives are salts which are not readily absorbed from the gastro-intestinal tract, and they act entirely by salt action (see under **Osmosis**). Osmotic pressure is set up by attracting water from the tissues into the lumen of the gut and at the same time stopping withdrawal of fluid from the gut. The fluid contents of the bowel are thus greatly increased, and the mere bulk stimulates the intestine to increased activity, whilst the increased amount of fluid softens hard scybala and so renders their passage easier.

Mercury Salts. Calomel, syn. Mercurous chloride, Hg_2Cl_2, is the common purgative salt of mercury. When given by the mouth it is to all intents not absorbed and gently stimulates peristalsis during its passage down the alimentary canal. It produces a soft greenish motion six to eight hours after ingestion. It is not a true cholagogue. See also under **Mercury.**

Laxatives (e. g. Prunes, Tamarinds, Figs) produce a mild cathartic action owing to a slight stimulant effect on the mucous lining of the intestine. They are free from griping in their action. Amongst laxatives may be included **Sulphur** and **liquid Paraffin,** which are of themselves inert. Sulphur is changed in the gut into H_2S and other sulphides, which stimulate the peristaltic mechanism. Sulphur is excreted mainly unchanged by the bowel, some as sulphide, whilst a small amount is absorbed and further changed before excretion in the urine as sulphate, and in minute amounts by the skin and breath. Liquid paraffin acts as a laxative entirely by its physical property of lubrication. Other bodies which are used as laxatives are—

Phenolphthalein (Purgen), a synthetic substance which has no irritant effect until it reaches the alkaline duodenum, when it is acted upon by the bile and thereafter exerts a mild irritant action on the bowel.

Agar-agar (Japanese isinglass) which owes its laxative effect to its power of absorbing water, in presence of which it swells up and by its bulk increases peristalsis in much the same way as do the saline purgatives.

Purgative Oils.

(a) Castor oil (oleum ricini), ʒ 1–8 (4–30 c.c.), obtained from the seeds of Ricinus communis, contains glycerides of ricinoleic acid. Castor oil in the natural state is a bland emollient oil: on saponification in the duodenum ricinoleic acid is set free, and this is an irritant which stimulates peristalsis. The seeds of Ricinus contains as well as the oil a substance, Ricin, a powerful vegetable toxin, which is apparently adsorbed or otherwise in close attachment to the albuminous bodies of the seed. See also under **Toxins.**

(b) Croton oil (oleum crotonis), ♏ ½–1 (0·03–0·06 c.c.), obtained from the seeds of Croton tiglium, contains as its active principle croton resin, a powerful irritant, in a free state in the oil. Croton oil, then, powerfully irritates the whole of the alimentary canal, including the stomach, whereas castor oil has no irritant properties whatsoever until it is saponified in the duodenum. As a purgative croton oil is very drastic, copious watery stools resulting, often streaked with blood and containing mucus.

Anthracene Purgatives. Rhubarb, senna, aloes and cascara contain amongst other substances chrysophanic acid or allied bodies, derived from anthraquinone by substitution of CH_3 and OH groups. It is on account of these anthraquinone derivatives that this group possesses its purgative action. The action is mild and devoid of inflammatory effect, and is due to a mild irritation exerted mainly low down in the bowel. Senna and aloes are said to act on the large intestine only. These anthracene bodies are absorbed to a small extent and excreted in the urine, which after rhubarb and senna is coloured deep yellow (changed to a purplish tone on addition of an alkali). Certain artificially-prepared anthracene bodies, such as purgatin and exodin have been introduced as substitutes: they appear to possess no advantage over the natural drugs.

Drastic Purgatives. (Jalap, scammony, elaterium, podophyllum, colocynth, euonymus, gamboge), contain irritant resins and acids to which the purgative action is due. As the name of the class implies, the action is somewhat violent, profuse watery stools resulting, and large doses are liable to produce inflammatory conditions of the intestine with blood-stained mucus in the evacuations. If any absorption takes place inflammation of the kidneys may occur during excretion. Euonymus is a member of the digitalis group. All drastic purgatives are liable to produce reflex effects on other viscera, particularly on the uterus (aloes is a favourite constituent of certain abortifacient compounds). Another effect of a drastic purge is to lower the blood-pressure by withdrawal of fluid from the tissues into the intestine.

Apart from the true purgatives, catharsis may be produced by other means such as (1) cathartic enemata; (2) any irritant finding its way into the alimentary canal; (3) any drug which stimulates the peripheral vagus, e. g. pilocarpine, physostigmine, etc.; (4) opium alkaloids in large doses, particularly apocodeine (depression of sympathetic ganglion-cells). See also under **Intestine,** drugs acting on.

PURGEN, syn. Phenolphthalein (q.v.).

QUASSIA. See under **Bitters** and **Anthelmintics.**

QUEBRACHINE, an alkaloid obtained from quebracho (q.v.).

QUEBRACHO. Two varieties of quebracho occur, the white which contains a number of alkaloids, quebrachine aspidospermine and others, and the red which contains a large amount of tannic acid and which is used commer-

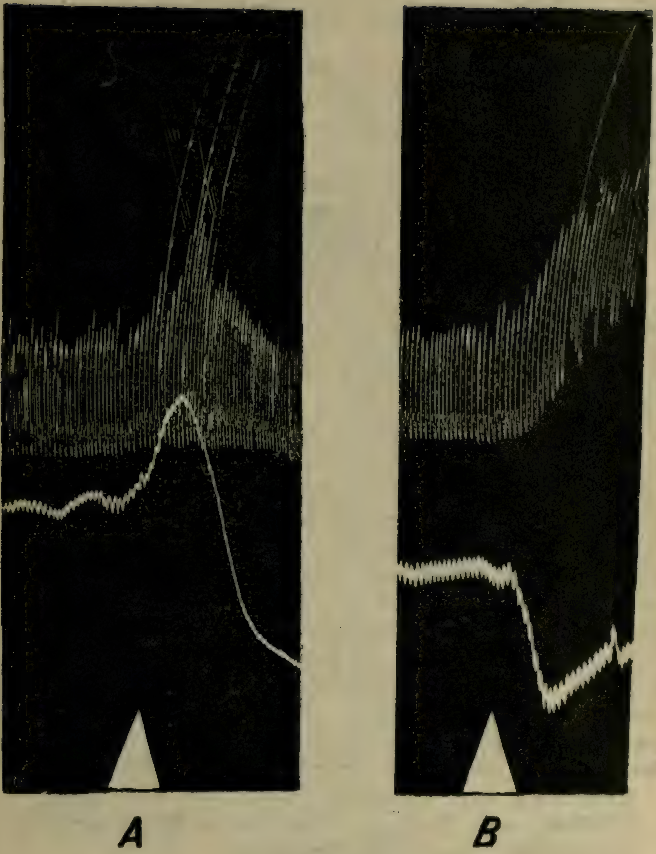


Fig. 12.

Cat, urethane: Respiratory movements (upstroke = inspiration) recorded by a tambour placed against the chest-wall in communication with a second recording tambour: carotid blood-pressure. In A an inhalation of prussic acid was given to the animal and in B an intravenous injection of pilocarpine. A shows the typical effect of a respiratory centre stimulant, and B that of a broncho-constrictor. Note that stimulation of the respiratory centre produces increased depth of respiration and that expiration is as complete as normally; whilst broncho-constriction (spasmodic asthma) results in a greatly impaired expiration, the chest becoming fuller and fuller of air (the inspiratory mechanism is stronger than the expiratory).

cially in the manufacture of leather. The alkaloids of quebracho exert a stimulant action on the medulla, particularly evident on the respiratory centre, and depress certain peripheral nerve-cells.

QUILLAIA. See under **Saponins.**

QUININE. See under **Antipyretics.**

RESINS. See under **Volatile oils.**

RESORCIN. See under **Antiseptics.**

RESPIRATION, drugs acting on. The respiratory movements may be influenced (a) through the medulla; (b) through the periphery. The respiratory centre is very sensitive to gaseous changes in the blood—a slight excess of CO_2 stimulates it to increased activity—similarly impulses reaching the centre through sensory nerves (e. g. as the result of application of ammonia vapour to the nostrils) produce a profound reflex effect on the respiratory movements. The centre may be directly affected by drugs which may either stimulate or depress it: the former resulting in increased and deeper respiratory movements and the latter in shallower and less frequent movements. To the former class belong strychnine, ammonium, etc., and to the latter chloroform and the anæsthetics and hypnotics generally. Certain other drugs such as prussic acid first stimulate and then depress the centre. Drugs affecting respiration through the periphery act mainly upon the bronchioles. See under **Bronchioles.** (See Fig. 12.)

RHATANY, syn. Krameria. See under **Astringents.**

RHEUM, syn. Rhubarb. See under **Purgatives.**

RHUBARB. See under **Purgatives.**

RICIN. See under **Toxins.**

RICINUS. The seeds of Ricinus communis contain castor oil (see under **Purgatives**). The seeds must on no account be given as a substitute for the oil, since they contain in addition a highly toxic body, ricin (q.v.).

ROCHELLE SALT, syn. Sodium potassium tartrate, *gr.* 120–240 (8–15 *Gm.*), a saline purgative (see also under **Purgatives** and under **Tartrates**).

RUBEFACIENTS are bodies which when applied to the skin produce a local vasodilatation with a feeling of warmth. The dilatation of surface vessels is the result of a local reflex. Most rubefacient drugs are either intense irritants, such as cantharides, or highly volatile bodies, such as chloroform or the volatile oils. Rubefacient action, if prolonged, or of sufficient intensity, merges into a vesicant (producing blisters) or even into a pustulant action.

SABINOL, oil of savin. See under **Volatile oils.**

SACCHARIN, syn. Gluside, $C_6H_4{\cdot}SO_2CO{\cdot}NH$, *gr.* $\frac{1}{2}$–2 (0·03–0·12 *Gm.*), a white, intensely sweet, crystalline powder. It is soluble to the extent of only 1–400 of water. Soluble saccharine (saccharine in combination with soda) is easily soluble in water. Saccharine is used as a sweetening agent, particularly for diabetics, and in ordinary doses produces no harmful effects.

SACCHARUM, sugar, used as a flavouring agent. See also under **Pharmacopœial preparations.** Dextrose is added to Ringer's solution (1 *Gm.* per litre) in the preparation of perfusion and immersion fluids for certain work on surviving organs.

SALICIN, *gr.* 5–20 (0·3–1·2 *Gm.*)—a glucoside which splits up in the body with the formation of salicylic acid. See under **Antipyretics.**

SALICYLATES. See under **Antipyretics.**

SALICYLIC ACID. See under **Antipyretics.**

SALOL. See under **Antiseptics.**

SALTS. See under **Osmosis.**

SALT ACTION. See under **Osmosis.**

SALVARSAN. See under **Arsenic.**

SANDALWOOD OIL. See under **Volatile oils.**

SANTALOL. See under **Volatile oils.**

SANTONIN. See under **Anthelmintics.**

SAPO, soap. See under **Pharmacopœial preparations.**

SAPONARIA. See under **Saponins.**

SAPONINS, glucosidal bodies which are soluble in water, such solution frothing when shaken. Saponins are found in a number of plants such as saponaria, quillaia, senega, digitalis, etc. Saponins are **general protoplasmic poisons,** highly irritant (to this irritant action on the gastric mucous membrane is due the expectorant action), producing nausea, vomiting and diarrhœa if taken by mouth. They combine with lipoids and so alter the physical properties of cell-membranes.

SAVIN. See under **Volatile oils.**

SCAMMONY, the root of Convolvulus scammonia. See under **Purgatives.**

SCILLA, syn. Squill, the bulbs of Urginea maritima. See under **Digitalis.**

SCOPARIUM, broom-tops, contains an alkaloid, sparteine, and a resinous body, scoparin; the latter has some diuretic action. See under **Diuretics.**

SCOPOLAMINE, syn. Hyoscine (q.v.).

SEATS OF ACTION OF DRUGS. Reference to Fig. 13, and the classified lists of drugs will give a general idea of the main pharmacological actions of these and of the points on which they act. The list does not pretend to be comprehensive; only the more important are included.

See also under drugs acting on **heart, pupil, salivary gland, bronchioles, uterus, intestine,** etc.

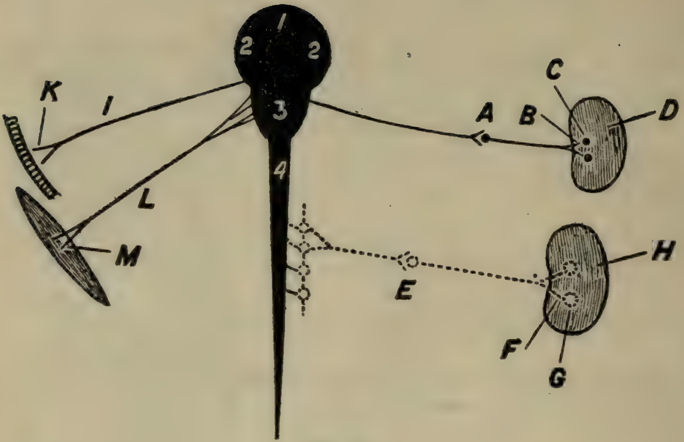


Fig. 13.

CNS.

1. Higher psychical centres.
2. Motor areas and mid-brain.
3. Medulla oblongata.
4. Spinal cord.

Peripheral System.

A = Ganglion-cell on the course of a cranio-sacral autonomic (para-sympathetic) nerve.
B = Anatomical nerve-endings of cranio-sacral autonomic (para-sympathetic) nerve.
C = Myoneural junction of cranio-sacral autonomic (para-sympathetic) nerve.
D = Plain muscle (or gland-cell) end-organ supplied by cranio-sacral autonomic (para-sympathetic) nerve.
E = Ganglion-cell on the course of a sympathetic nerve.
F = Anatomical nerve-endings of a sympathetic nerve.
G = Myoneural junction of a sympathetic nerve.
H = Plain muscle (or gland-cell) end-organ supplied by a sympathetic nerve.
I = Sensory nerve.
K = Nerve-ending of sensory nerve in the skin.
L = Motor nerve.
M = Nerve-ending of motor nerve in voluntary muscle.

For these references see opposite page :—

* + = stimulation. − = depression or paralysis.
+ − = initial stimulation followed by depression.

(1234) = affecting these parts in the order mentioned (e. g. chloroform depresses from above downwards, physostigmine from below upwards).

DRUGS ACTING CENTRALLY.

* Alcohol — (1234)
Chloroform — (1234)
Ether — (1234)
Chloral hydrate — (1234)
Morphine — (1234)
Cannabis Indica — (1234)
Physostigmine — (4321)
Caffeine + (1234)
Ammonium + (1234)
Strychnine + (4, and in lesser degree 321)

Digitalis + (3)
Apomorphine + (3)
Cocaine + — (1234)
Atropine + — (1234)
Hyoscyamine (+) — (1234)
Hyoscine (+) — (1234)
Aconitine + — (3)
HCN + — (3)

DRUGS ACTING PERIPHERALLY.

On **A** *and* **E.**

Nicotine + —
Coniine + —

Lobeline + —
Ergotoxine + —

Apocodeine (+) —
Curare —

On **B.**

Physostigmine +
Digitalis +
Aconitine + (—)

Veratrine + (—)
Apocodeine (+) —
Atropine —

Hyoscyamine —
Hyoscine —
Morphine —
Curare —

On **C.**

Pilocarpine +
Muscarine +
Arecoline +

Colchicine +
Apocodeine (+) —
Atropine —

Hyoscyamine —
Hyoscine —

On **D** *and* **H.**

Barium +
Veratrine +
Physostigmine +
Pituitrin +
Histamine +

Calcium +
Digitalis +
Aconitine +
Alcohol + —
Quinine + —

Potassium —
Chloroform —
Chloral hydrate —
Nitrites —
HCN —
Caffeine + —

On **F.**

Cocaine + —

Apocodeine (+) —

On **G.**

Adrenalin +
Tyramine +

(Pilocarpine +)
Ergotoxine + —

Apocodeine (+) —

On **I** *and* **L.**

Cocaine (+) —

On **K.**

Cocaine + —

Atropine —

On **M.**

Physostigmine +
Veratrine +

Aconitine + —
Curare —

SECALE CORNUTUM, horned rye, the diseased rye from which ergot is obtained. See under **Ergot.**

SENEGA. See under **Saponins.**

SENNA. See under **Purgatives.**

SERUM THERAPY. See under **Toxins.**

SEVUM, suet. See under **Pharmacopœial preparations.**

SILVER. The pharmacological action of silver is essentially similar to that of the other heavy metals (q.v.). Silver nitrate is the only form in which this metal is extensively used in medicine, and this only for its local caustic effect. The symptoms of poisoning by silver (argyria) are similar to those produced by lead—gastro-enteritis and, if absorbed, nervous symptoms, with a black line on the gums and a dark pigmentation of the skin.

SOAMIN. See under **Arsenic.**

SOAP. See under **Pharmacopœial preparations.**

SODIUM. The sodium ion has no specific pharmacological action; like the chloride ion it forms a large proportion of the normal constituents of the tissues.

SOMNOFORM, a mixture of ethyl chloride, ethyl bromide and methyl chloride. See under **Anæsthetics.**

SOPORIFICS. See under **Hypnotics.**

SPANISH FLY, syn. Cantharides. See under **Irritants.**

SPARTEINE, a liquid alkaloid obtained from scoparium, paralyses sympathetic nerve-cells in much the same way as nicotine and coniine, but there appears to be less initial stimulation. Sparteine has no diuretic effect.

SPEARMINT. See under **Volatile oils.**

SPIRITUS. See under **Pharmacopœial preparations.**

SQUILL, syn. Scilla. See under **Digitalis.**

STANDARDISATION. Drugs which are pure chemical bodies require no standardisation; others which consist of a mixture of chemical bodies may be standardised by a quantitative chemical method. Certain other drugs remain for which no reliable method of chemical assay is at present possible. Such drugs are usually assayed or "standardised" by biological means. The more important of these drugs are digitalis and other members of the group, ergot, cannabis indica, adrenalin and pituitrin.

Digitalis is usually assayed by determining the minimal amount necessary to bring to a systolic standstill in a given unit of time the heart of a freshly caught male frog of a given weight.

Ergot. Since ergotoxine is the least stable of the active principles the logical assay method would be one which took account of the ergotoxine content. This can be done with moderate accuracy by determining the smallest dose of the ergot which is necessary to paralyse the vasoconstrictor mechanism (Dale's vasomotor paradox) in an animal of given weight. The usual method of assay, however, does not particularise the ergotoxine, but consists simply in ascertaining the minimal amount of the whole ergot which is necessary to raise the blood-pressure of an animal of given weight a given number of millimetres of mercury. This method of course lumps together the ergotoxine and tyramine effects.

Cannabis Indica is usually assayed by determining the dose per kilogram of test-animal (preferably a dog) necessary to produce physiological cerebral symptoms.

Adrenalin is usually assayed by determining the minimal dose necessary to raise the blood-pressure of an animal of given weight a certain number of millimetres of mercury.

Pituitrin may be assayed by (a) the blood-pressure method similar to that employed for ergot and for adrenalin, with the proviso that injections of the new sample and of a "standard" pituitrin must be given alternately and at equal intervals of time. This proviso is necessary because the vasomotor mechanism of an animal varies greatly in sensitiveness to succeeding doses of pituitrin; (b) the isolated uterus method, in which the concentration of a new sample necessary to increase the uterine tonus to an equivalent extent to that produced by a known concentration of a "standard" solution is determined. Here again it is necessary to apply the new sample and the standard alternately and at equal time intervals : moreover, it is essential that the uterine responses are submaximal. The isolated uterus method is considerably more accurate than the blood-pressure method, and it has the great advantage that successive applications can be made at much shorter intervals than are required in the blood-pressure method. In all these biological assay methods considerable experience is necessary before an individual becomes competent to form justifiable conclusions from his observations.

STAVESACRE (delphinium staphisagria) contains an alkaloid, delphinine, whose pharmacological action is similar to that of aconitine (q.v.).

STEAROPTENE, a crystalline oxidation product of a volatile oil. See under **Volatile oils.**

STOVAINE. See under **Cocaine.**

STRAMONIUM, the leaves of datura stramonium contain alkaloids, atropine, hyoscyamine and hyoscine. See under **Atropine.**

STROPHANTHIN, *gr.* 1/300–1/100 (0·0002–0·0006 *Gm.*), a glucoside obtained from different species of strophanthus. See under **Digitalis.**

STROPHANTHUS. See under **Digitalis.**

STRYCHNINE, *gr.* 1/64–1/16 (0·001–0·004 *Gm.*), an alkaloid from the seeds of strychnos nux vomica, which contains also another alkaloid, brucine, some tannic acid and glucosidal bodies.

In the mouth strychnine has a strongly bitter taste and produces the ordinary actions of a **bitter** (q.v.). **Absorption** takes place fairly rapidly from the small intestine. It produces a profound action on the **CNS** particularly on the spinal cord. It appears to stimulate and render hypersensitive some part of the sensory side of the reflex arcs in the cord, whereby all reflexes are greatly intensified both in depth and wideness of spread. If the ear of a normal dog be scratched, the dog responds by a reflex scratching of his body with his hind leg on the side to which the stimulus is applied. If in the same way a strychninised dog be tickled behind the ear, the reflex response is that the whole animal goes into convulsions. The seat of action is not in the brain—convulsions take place equally well in the decerebrate animal: it is not on motor nerve-endings—section of the nerves prevents convulsions in the muscles supplied by the nerves that are cut: if all sensory nerve-endings are paralysed, or if the sensory nerves are cut, no convulsions take place; therefore some definite sensory stimulus appears to be necessary for the initiation of a convulsion (convulsions can be shown to follow immediately on the application of some stimulus, such as a touch or a flick to the skin of a strychninised animal). This action of strychnine on the cord may be appreciated by comparing the animal's central nervous mechanism with a telephone exchange. Under normal conditions a subscriber rings up the exchange and gets connected with the number he desires to ring up. So in the normal animal a definite stimulus is followed by a definite and co-ordinated response. Suppose now that the operator in the telephone exchange vacates her post for a moment, and during her absence some mischievous person enters the exchange and connects up the afferent wire from subscriber "X" with the wires leading to all the other instruments on the system; then when subscriber "X" takes his receiver off the hook he sets ringing all the bells on all the instruments connected with the exchange. So in the strychninised animal, any slight sensory impulse reaching the cord spreads out through all the synapses and initiates impulses down every motor nerve leaving the cord. To such an extent is the cord picked out by strychnine in preference to the brain that as a rule muscles supplied by spinal nerves take part in convulsions, whilst those supplied by cranial nerves do not contract.

Doses of strychnine too small to provoke actual convulsions increase the tonus of all muscles supplied by spinal nerves. It is presumed that the action here, too, is on the cord, similar in kind though less intense than that which gives rise to convulsions. The **medulla** is affected similarly—exaggerated respiratory and vasomotor reflexes being seen after the strychnine. The **cerebrum** is but slightly affected—the motor area is rendered rather abnormally irritable, with consequent restlessness. By its action on the brain strychnine renders **special senses** more acute, and certain of them are often rather modified, so that disagreeable smells become less unpleasant, and the field of vision for blue colours in particular becomes enlarged.

Plain muscle is stimulated directly; thus there is vasoconstriction (partly medullary and partly peripheral) of splanchnic vessels with dilatation of cutaneous vessels. The amplitude of the heart-beat is increased and blood-pressure rises, and the tonus of other plain muscle is increased. A certain **aphrodisiac** action is described, the sexual reflexes being increased in common with other reflexes. The **body-temperature** is usually raised secondarily to the generally increased movements and increased metabolism: sometimes a fall in temperature takes place from the increased heat-loss dependent on the cutaneous vasodilatation. In cases of **strychnine poisoning** death occurs from asphyxia: the respiratory muscles become fixed in a strong contraction (entailing an enormous oxygen consumption, in consequence of which the onset of asphyxia is rapid). **Excretion** is mainly in the urine and is slow.

SUCCI. See under **Pharmacopœial preparations.**

SUET (sevum). See under **Pharmacopœial preparations.**

SUGAR. See under **Pharmacopœial preparations.**

SULPHATES are absorbed with difficulty from the alimentary canal. They have no specific action. When given by the mouth sulphates (e. g. of sodium and magnesium) exert their salt action in the direction of increasing the fluidity of the intestinal contents, and so act as saline purgatives (see under **Osmosis**). If injected into the circulation sulphates produce a profound diuresis with some increase in oxygen consumption by the kidney. Sulphates combine in the tissues with aromatic bodies like indol and phenol to form ethereal sulphates, in which form a small proportion of all sulphates is excreted.

SULPHIDES. See under **Sulphur.**

SULPHITES are used as gastric antiseptics: they act by reduction. Sulphur dioxide is liberated in the stomach. Sulphites are used externally as antiparasitic applications in certain parasitic skin diseases.

SULPHONAL $(CH_3)_2 \cdot C \cdot (SO_2C_2H_5)_2$, *gr.* 10–30 (0·6–2 *Gm.*). See under **Hypnotics.**

SULPHUR is of itself an inert body: such pharmacological actions as are ascribed to it are due to sulphide which is formed (a) by interaction with secretions, as on the skin to which sulphur is applied in ointment form; (b) in the intestine: the H_2S here formed stimulates the gut to increased peristalsis. Generally speaking wherever sulphide is formed it irritates the tissues with which it comes in contact: at the same time by reduction it acts as an antiseptic and parasiticide and changes hæmoglobin in vitro. **Excretion** is mainly in an unchanged form by the bowel, some is changed into sulphide and either excreted as such or absorbed and excreted in the urine as sulphate. Traces too are excreted by the breath, sweat and sebaceous glands.

SUPPOSITORIA. See under **Pharmacopœial preparations.**

SYRUPI. See under **Pharmacopœial preparations.**

TAMARINDS. See under **Purgatives.**

TANNIC ACID, *gr.* 5–10 (0·3–0·6 *Gm.*). See under **Astringents.**

TANSY. See under **Volatile oils.**

TAR. See under **Antiseptics.**

TARTAR EMETIC (antimony and potassium tartrate), *gr.* ½–1 (0·03–0·06 *Gm.*). See under **Antimony** and **Emetics.**

TARTRATES are not absorbed very readily from the alimentary canal and produce some catharsis from salt action (see under **Osmosis**). Such part of a dose of tartrate as is absorbed is converted in the tissues into **carbonate** and excreted in this form in the urine, the alkalinity of which is in consequence increased.

TEA contains the alkaloid, caffeine (q.v.).

TETRONAL $(C_2H_5)_2\cdot C\cdot(SO_2C_2H_5)_2$, *gr.* 10–20 (0·6–1·2 *Gm.*). See under **Hypnotics.**

THEBAINE, an alkaloid of opium (q.v.).

THEOBROMINE, an alkaloid obtained from cacao (cocoa). See under **Caffeine.** Diuretin is theobromine-sodium salicylate.

THEOCINE, an isomer of theophylline (q.v.).

THEOPHYLLINE, a dimethylxanthine, an alkaloid found along with caffeine in tea. See under **Caffeine.**

THYME. See under **Volatile oils.**

THYMOL, *gr.* ½–2 (0·03–0·12 *Gm.*), or as an anthelmintic, *gr.* 15–30 (1–2 *Gm.*), a stearoptene. See under **Volatile oils** and **Anthelmintics.**

THYROGLOBULIN. See under **Thyroid gland.**

THYROID GLAND. The active principle of this gland of internal secretion is contained in the thyroglobulin of the colloid material. Iodine enters into the composition of this and it is found that the iodine content and the activity of the gland follow parallel curves. The thyroid contains a large reserve store of the active principle, and in this way differs from other internally secreting glands such as the pituitary and suprarenals. The active principle of the thyroid is not destroyed by either peptic or tryptic digestion, and in consequence may be given by the mouth without risk of destruction before absorption. (Cf. pituitary and suprarenal.) Thyroid gland extract is widely used in substitution therapy in the different varieties of hypothyroidism—cretinism, myxœdema, hyperplastic goitre and cachexia strumipriva—also in other conditions with a symptom-complex indicating minor degrees of thyroid insufficiency. In hyperthyroidism (Graves' disease) on the other hand the use of thyroid extract is not only illogical but actually dangerous. Thyroid extract is used too in conditions of arterio-sclerosis. Iodides too are widely used in the treatment of these conditions, and it appears quite possible that the beneficial effects of iodides are here due solely to their power of increasing the activity of the thyroid gland. Thyroid extract produces a great increase in metabolism, with the nitrogen excreted and the respiratory exchange rising rapidly, with consequent loss of weight in the patient. Thyroid extract is a constituent of certain proprietary anti-obesity remedies: it is far too dangerous a drug to be used indiscriminately.

TINCTURÆ. See under **Pharmacopœial preparations.**

TOBACCO. See under **Nicotine.**

TOLERANCE. Different species of animals, and in some instances certain individuals of a species, may exhibit a tolerance to a certain drug. Such tolerance may be either **natural** or **acquired.** In the former class we have the natural tolerance of the rat to strophanthus and to histamine and the natural tolerance of herbivora generally to atropine, whilst the Styrian peasants habitually acquire a tolerance to arsenic in much the same way as the confirmed opium eater or smoker acquires the tolerance to morphine. One should bear in mind that under certain conditions parasites may acquire a tolerance to a drug quite as quickly as, if not more quickly than, the host: trypanosomes very rapidly become tolerant to the organic arsenicals, and in consequence one must endeavour to effect a *sterilisatio magna* with one or two injections of large doses rather than try to kill the parasite with repeated small doses.

TOXINS are specific poisonous bodies of complex structure, to most or all of which the animal body has the power of forming antitoxins. Each specific disease-producing bacterium produces its specific toxin. The individual antitoxin is as specific as the corresponding toxin: thus diphtheria antitoxin will neutralise the toxin of the diphtheria bacillus but is ineffective against the toxin of any other organism. A few plants have been found to contain bodies which behave like the toxins; such bodies are ricin from castor oil seeds, abrin from the seeds of jequirity and crotin from croton oil seeds. These bodies have been termed vegetable toxins, or, from the close adherence of the toxin to the albumin or globulin of the seed, toxalbumins or toxoglobulins. Antitoxins to these bodies have been produced. Snake venom behaves in much the same way as the toxins: and again an antibody, antivenin, has been produced. The specificity of the venom and antivenom of different snakes does not appear to be so absolute as that of true toxins.

TRAGACANTH, a gummy sap obtained from different varieties of astragalus. See under **Demulcents** and **Pharmacopœial preparations.**

TRINITRIN. See under **Nitrites.**

TRIONAL, syn. Methyl-ethyl-sulphonal, $CH_3{\cdot}C_2H_5{\cdot}C{\cdot}(SO_2C_2H_5)_2$ *gr.* 10–20 (0·6–1·2 *Gm.*). See under **Hypnotics.**

TROCHISCI. See under **Pharmacopœial preparations.**

TROPEINE, an artificial combination of the tropine nucleus with an aromatic acid. Atropine is a combination of tropine and tropic acid: homatropine of tropine with mandelic acid. See under **Atropine.**

TROPINE. See under **Atropine.**

TROPACOCAINE. See under **Cocaine.**

TURPENTINE. See under **Volatile oils.**

TYRAMINE. See under **Ergot** and **Amines.**

UNGUENTA. See under **Pharmacopœial preparations.**

URARI. See under **Curare.**

UREA. See under **Diuretics.**

URETHANE. See under **Hypnotics.**

URGINEA (squills). See under **Digitalis.**

UROTROPINE, syn. Hexamine. See under **Antiseptics.**

UTERUS, drugs acting on. The innervation of the uterus is derived entirely from the true sympathetic system, but the function of the sympathetic to the uterus varies in different animals, and in some apparently its function changes in different physiological states of this organ. Thus adrenalin, a drug which reproduces faithfully the effect of sympathetic stimulation, inhibits and relaxes the uterus of the guinea pig, contracts the uterus of the rabbit, and in the case of the cat it relaxes the non-pregnant uterus and contracts the organ when pregnant. There are thus three types of uterus, and it seems simplest to assume that in one type (A)—*vide* diagram—the sympathetic supplies a preponderance of inhibitor fibres: in type B the motor and inhibitor fibres are fairly evenly balanced: and in type C the motor fibres outnumber the inhibitor fibres.

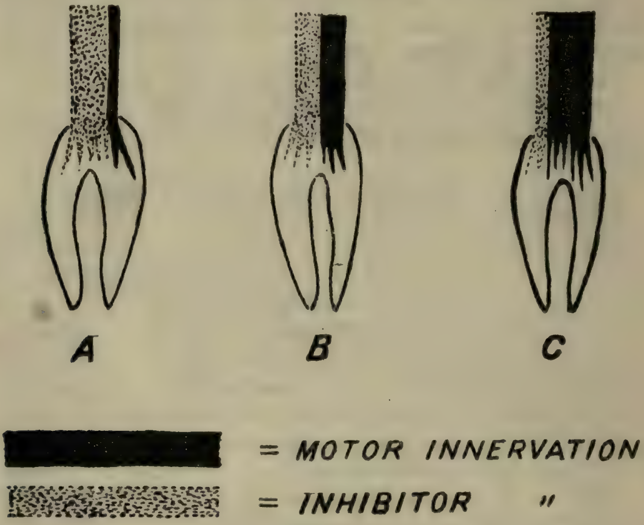


Fig. 14.

The reaction of the uterus then to any drug which stimulates any part of the sympathetic innervation will depend on the type to which the uterus in question belongs.

Drugs acting on the central nervous system appear to have but little effect on the uterus. Scopolamine and morphine have been used together very largely of recent years to produce a condition of amnesia ("Twilight Sleep") during labour; the central nervous system is profoundly depressed; the uterus is little or not at all affected. Drugs which directly stimulate or depress the plain muscle cause the uterus to contract or to relax irrespective of the type of uterus and irrespective of the functional condition of the organ.

Reflex uterine contractions may be brought about by any substance, such as an irritant drastic purgative, which produces general congestion of pelvic viscera. Aloes is a common ingredient of abortifacient and emmenagogue preparations. Counter-irritation too, as by a mustard plaster over the sacrum or by a hot vaginal douche, may produce similar effects.

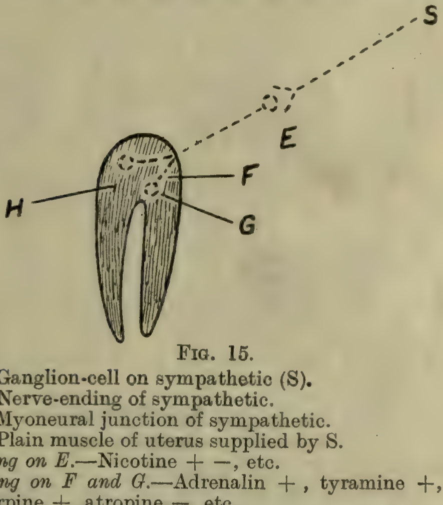


FIG. 15.

E = Ganglion-cell on sympathetic (S).
F = Nerve-ending of sympathetic.
G = Myoneural junction of sympathetic.
H = Plain muscle of uterus supplied by S.

Drugs acting on E.—Nicotine + −, etc.

Drugs acting on F and G.—Adrenalin +, tyramine +, ergotoxine + −, pilocarpine +, atropine −, etc.

Drugs acting on H.—Barium +, heavy metals +, histamine +, pituitrin +, chloroform −, K −, nitrites −, etc.

UVA URSI (Bearberry), the leaves of this plant contain two glucosides, **Arbutin** and **Methyl Arbutin,** which possess some slight diuretic and antiseptic properties. See under **Diuretics.**

VALERIAN, the root of Valeriana officinalis, contains a **Volatile oil** (q.v.).

VASOCONSTRICTORS. See under **Blood-vessels,** drugs acting on.

VASODILATORS. See under **Blood-vessels,** drugs acting on.

VERATRINE, *gr.* 1/64–1/16 (0·001–0·004 *Gm.*), an alkaloidal mixture contained in veratrum sabadilla and in other species. Generally speaking the action of veratrine resembles closely that of aconitine (q.v.). In addition to this aconitine-like action veratrine has a marked action on all forms of **muscle.** Striped muscle is stimulated to increased irritability, so that a given stimulus produces an increased response and the relaxation following this is greatly prolonged. The tonus and movements of plain muscle are increased, so that vomiting, colicky pains, uterine contraction, constriction of all blood-vessels result. The tonus of cardiac muscle is increased, at first with some slowing of the beat, though later this is quickened : cardiac output is increased at first.

VERONAL, syn. Barbitone, *gr.* 5–10 (0·3–0·6 *Gm.*). See under **Hypnotics.**

VERMICIDES. See under **Anthelmintics.**

VERMIFUGES. See under **Anthelmintics.**

VESICANTS. See under **Irritants.**

VINA. See under **Pharmacopœial preparations.**

VIRGINIAN PRUNE, the bark of this contains a glucoside allied to amygdalin, which is readily split up with the formation of **Prussic acid** (q.v.).

VOLATILE OILS, which are mixtures of bodies like pinene, are obtained from a variety of plants. It is to the presence of the volatile, or essential, oil that the typical scent of the plant is due. These pinene bodies are derivatives of **benzene** and are known under the generic name of **Terpenes.**

Volatile oils are insoluble in water, soluble in alcohol, chloroform, etc., and cannot be saponified like the fixed oils or fats. They may be classified as follows—

1. **Turpentine Group.**
    - A. Oils and Oleo-resins.
    - B. Resins.
    - C. Tars.
    - D. Balsams.

2. **Carminative Group** (including flavouring agents), e. g. peppermint, cloves, cajuput, etc.

3. **Malodorous Group,** e. g. asafetida, valerian.

4. **Urinary Disinfectant Group,** e. g. juniper, sandalwood, copaiba.

5. **Abortifacient Group,** e. g. tansy, pennyroyal.

6. **Stearoptene Group** (crystalline oxidised products of volatile oils), e. g. camphor, thymol, menthol.

As a class the volatile oils are **general protoplasmic poisons :** in sufficient concentration they are efficient germicides. (See under **Antiseptics.**) Internally they may be used to check fermentation and bacterial action in the alimentary canal. In the tissues it is probable that they do not reach micro-organisms in sufficient concentration to act efficiently as germicides, but here their volatility is of use : they are soluble in lipoids and permeate freely through the tissues, and so can reach deep-seated organisms with far greater ease than can most antiseptics. The gonococcus lies deep in the urethral tissues and can be reached by such oils as those of sandalwood and copaiba which are excreted in the urine, whereas other antiseptics in the urine might fail to reach such organisms. On the **skin** the volatile oils act as **rubefacients :** applied to mucous membranes they first stimulate and then depress sensory nerve-endings, producing a feeling of warmth followed by one of numbness. In the **stomach** they are mildly antiseptic and by producing a local vasodilatation they increase the flow of gastric juice : by direct action on the musculature they dislodge accumulations of gas, and so produce eructations and relieve flatulence and colic (carminative action). **Absorption** is rapid and they circulate in the tissues unchanged. Large doses, such as are not used in therapeutics, first stimulate and then depress the **CNS.** **Excretion** takes place by the lungs, the kidneys and the sweat-glands, all of which are gently stimulated during the process of excretion, so that the volatile oils possess some **expectorant, diuretic** and **diaphoretic** action. The odour of a volatile oil which has been ingested is usually noticeable in the breath. In the urine they are found in combination with **glycuronic acid,** and such urine frequently has a characteristic odour : thus turpentine taken by the mouth produces a urine with a sweet odour like that of wall-flowers. The so-called abortifacient volatile oils possess no true abortifacient effect (the direct effect of a volatile oil is to relax the uterine muscle). Any action in this direction must be ascribed to the general protoplasmic poisonous action of the oils : doubtless they are taken in the hope that the fœtal protoplasm will be poisoned before the maternal tissues. It frequently happens that degeneration of various maternal viscera takes place long before abortion. In any case they are drugs which should find no place in legitimate therapeutics.

WINTERGREEN, oil of. See under **Antipyretics.**

WITCH HAZEL (hamamelis). See under **Astringents.**

XANTHINE. See under **Caffeine.**

XAXA, proprietary name for aspirin. See under **Antipyretics.**

YOHIMBINE, an aklaloid obtained from the bark of Corynanthe yohimbi. It stimulate the CNS, particularly the respiratory centre and spinal reflexes, and it has been used as an aphrodisiac. There is reason to believe that yohimbine and quebrachine (q.v.) are identical.

ZINC possesses all the actions of the **Heavy metals** (q.v.). It is used entirely for its astringent effect : an insoluble albuminate of the metal being formed. It is scarcely absorbed from the gastro-intestinal tract, and the only effects produced when it is taken by the mouth are those referable to irritation of the alimentary canal.

ZINGIBER (ginger). See under **Volatile oils.**

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D.J.H.
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